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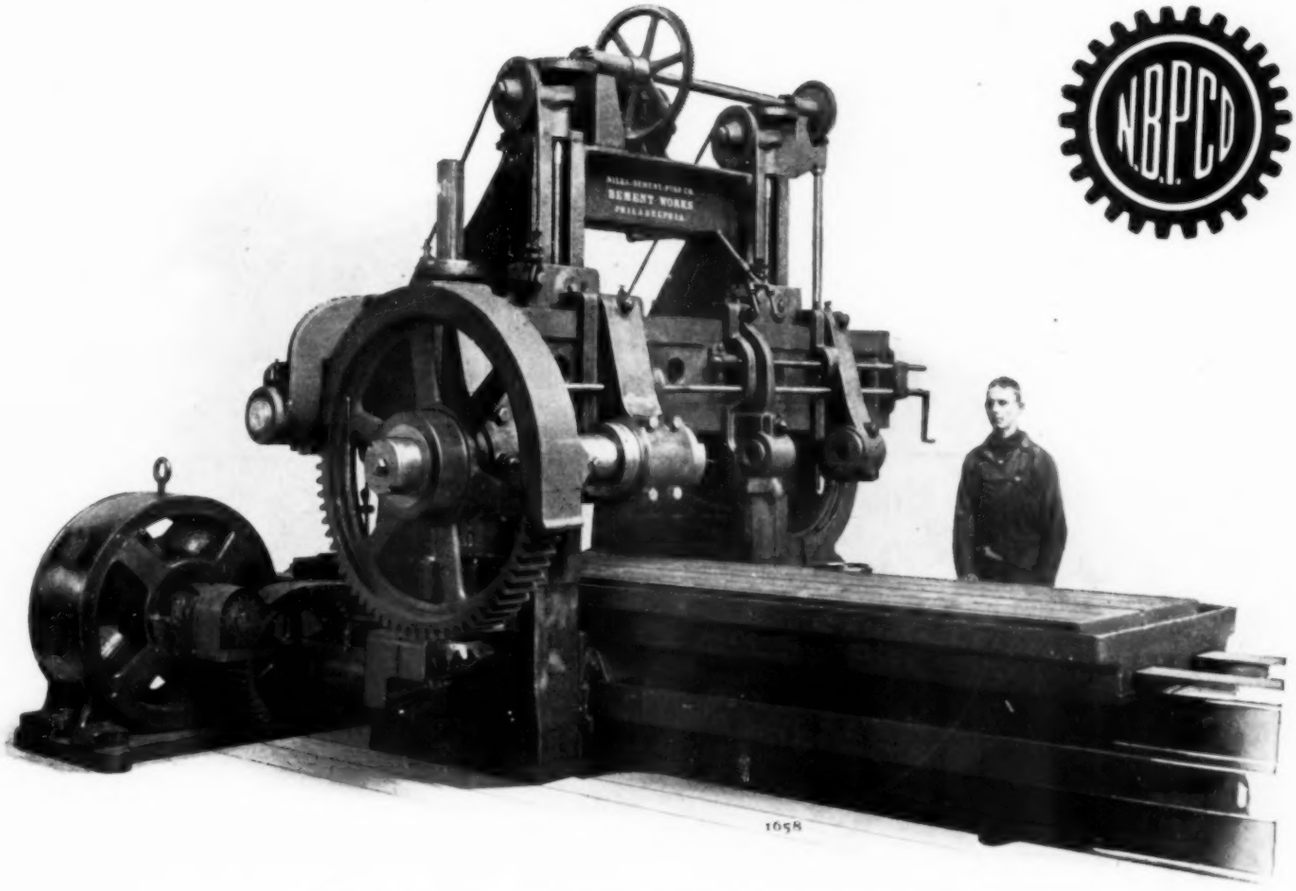
AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 31. 505 PEARL STREET, NEW YORK. No. 49.

Index to Advertisers and Classified Index Following Reading Matter.



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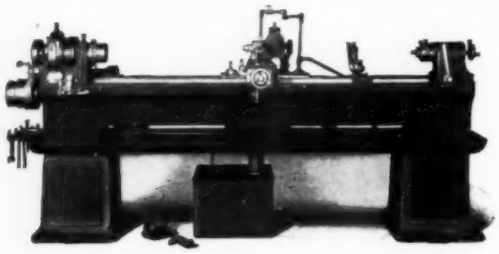

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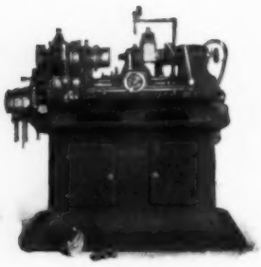

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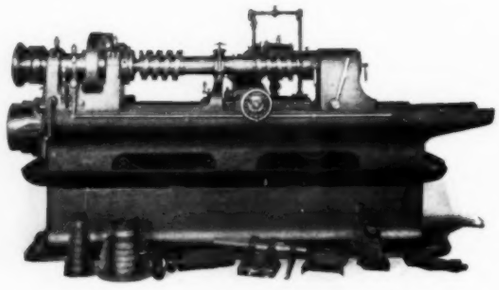

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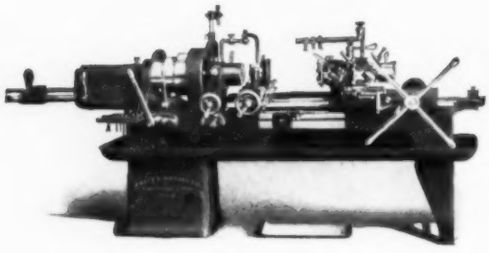

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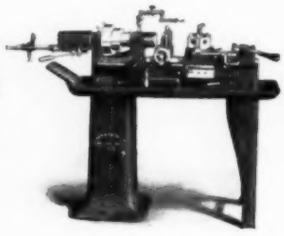

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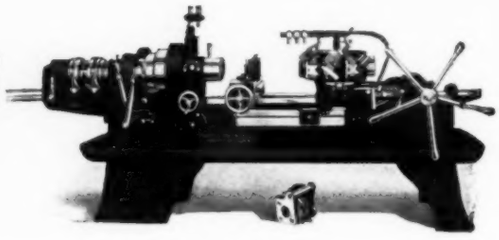

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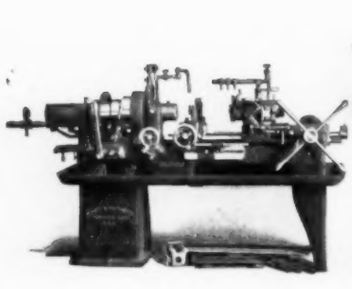

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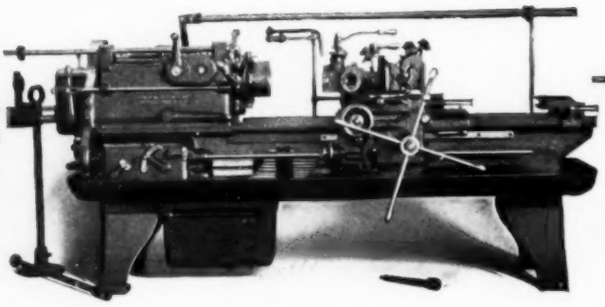

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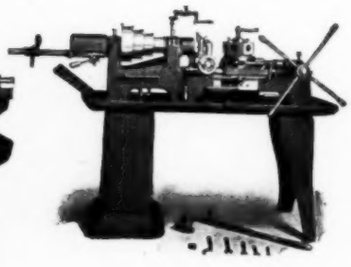

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SPECIAL CORRESPONDENCE

It is seldom our good fortune to come across such a line of special machine tools, and especially adapted standard machine tools, as is in use at the plant of the Hersey Manufacturing Company, South Boston, Mass. At this plant is manufactured the Hersey line of water meters, which includes disk, rotary, torrent and detector meters in a wide range of sizes, and adapted for many different uses. It goes without saying that the essential parts of a measuring device must be made with extreme accuracy. This statement is particularly true of the working parts of these water meters. In general the working parts of all of the meters are made either of government bronze or of hard rubber. The casings are either of bronze composition or iron, depending upon the size.

As the various lines of meters and their parts are well standardized, highly organized methods of production have been developed in order to produce an accurate, and at the same time a cheapened product. A wide use has been made of automatic and semi-automatic machine tools, special fixtures, gages and the like. In this article we shall deal more particularly with the machine tools, fixtures and methods employed in the manufacture of some of the small and accurate parts. A following article will deal with interesting details of equipment, including the testing floor where every meter is carefully tested and inspected before shipment. The sectional view of the disk meter illustrated, Fig. 1A, shows the parts which are manufactured with the machines described below.

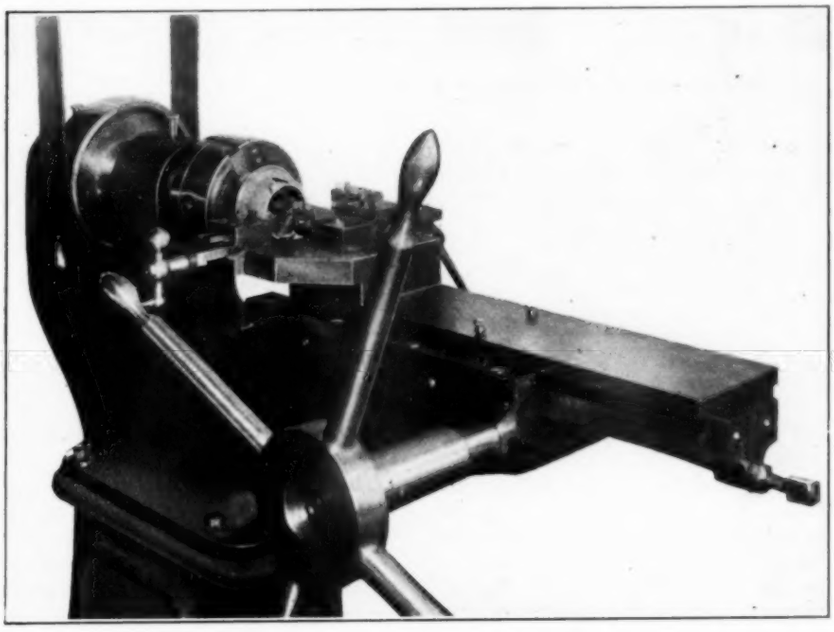


FIG. 1. A SPECIAL TURNING MACHINE

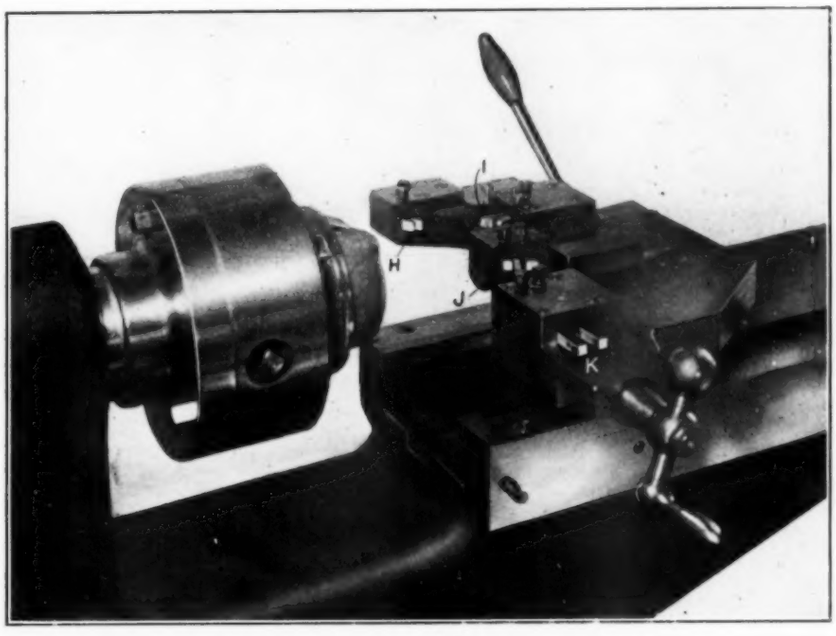


FIG. 2. ARRANGEMENT OF THE TOOLS OF THE TURNING MACHINE

Special Turret Machinery

Figs 1, 2, 4 and 5 show two special machines, designed and built at the

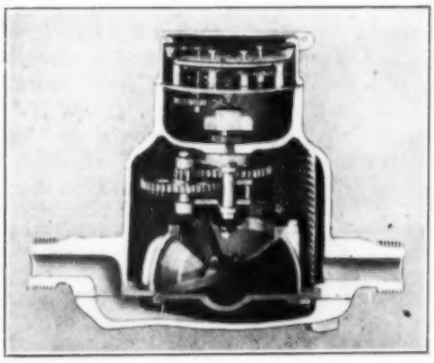


FIG. 1A. SECTIONAL VIEW OF A HERSEY DISK METER

Hersey plant, to machine small brass rings for disk meters. Fig. 3 shows one of these rings in section. The machine shown by Figs. 1 and 2 machines the surfaces *A, B, C* and *D* and part of *E*. The machines shown by Figs. 4 and 5 machines the surfaces *F, G, D* and part of *E*.

The machines are similar in construction and their general lines are shown clearly. Each has a chuck on a spindle driven by an open belt, and a long slide operated by a pilot wheel and carrying a special tool holder and tools. At the rear of each slide is a large stop screw limiting the forward movement of the turret. The machine shown in Figs. 4 and 5 is pro-

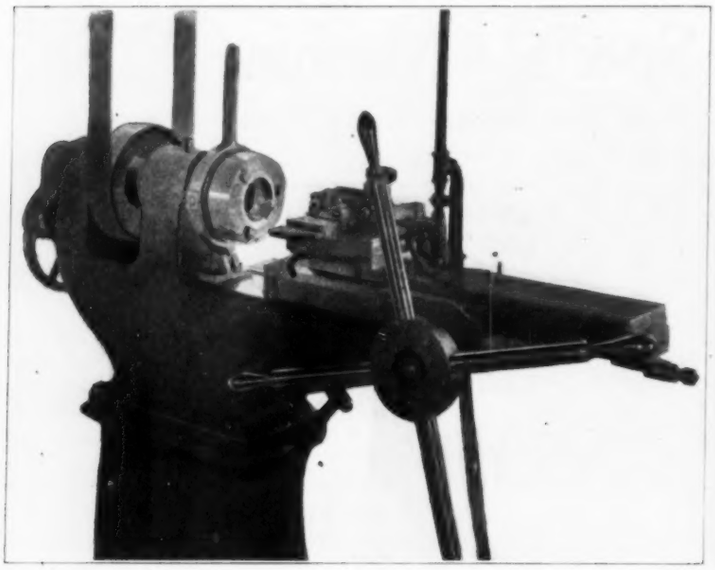


FIG. 4

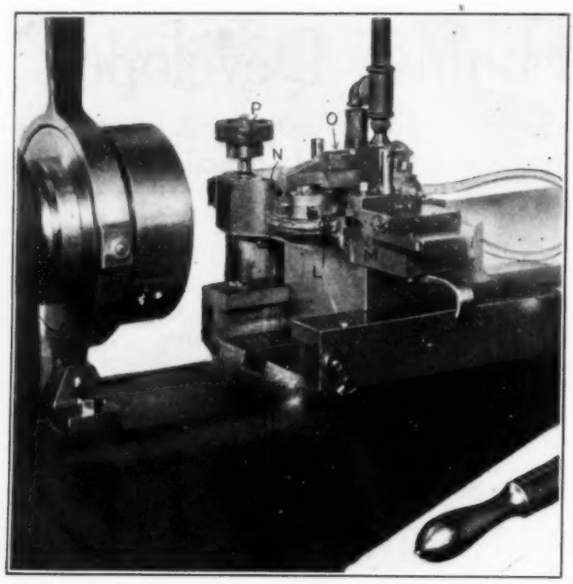


FIG. 5

ANOTHER SPECIAL TURNING MACHINE

vided with a power feed. The feed of the machine shown by Figs. 1 and 2 is by hand.

These two machines entirely finish a ring casting as far as turning is concerned. Each casting has only one setting in each machine.

The first machine grasps the rough casting on the inside by means of a three-jawed chuck. The slide carries four sets of tools, indicated by the letters *H, I, J* and *K* in Fig. 2. Each set of tools is composed of a rougher and a finisher. Group *H* finishes the surface *A* of Fig. 3; group *I* finishes the surface *C; J* surface *D*, and group *K* surfaces *E* and *B*. Group *I* is controlled by the hand lever shown at the back of the machine, groups *H J* by the pilot wheel and group *K* by the handle in front and the pilot wheel. Each group of tools is worked to a stop so that the cuts are automatically gaged. Needless to say, the operation of the machine takes far less time in the finishing of a casting than does this description.

The machine illustrated by Figs. 4 and 5 is provided with a special chuck that holds

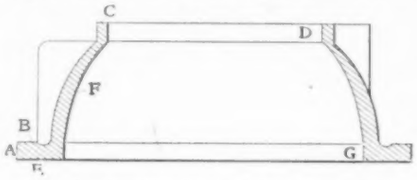


FIG. 3. SECTION OF A DISK METER RING

the castings after they have received their first machining by the machine of Fig. 1. The chuck has a formed cavity shaped to the contour of the outside of the casting. The piece is grasped by three jaws which are under spring tension and are operated by the handle shown projecting directly upward, and immediately back of the chuck. The slide contains four tools indicated by the letters *L, M, N* and *O* in Fig. 5. The tool indicated by the letter *L* machines the surface *G* which is cylindrical, and the surface *F* which is spherical. The tool is set in a circular revolving holder that is shown plainly. Tool *N* roughs the surface *E;* tool *M* finishes it. The small tool indicated by the letter *O* slightly chamfers the corner formed by surfaces *E* and *G*.

This slide is provided with a power feed, taken from a feed shaft on the back of the machine and two gears at head end. An upright shaft ending in the hand wheel *P* is driven by a worm wheel from this feed shaft. This shaft carries a spur gear that drives a system of racks, and these racks through other spur gears control the

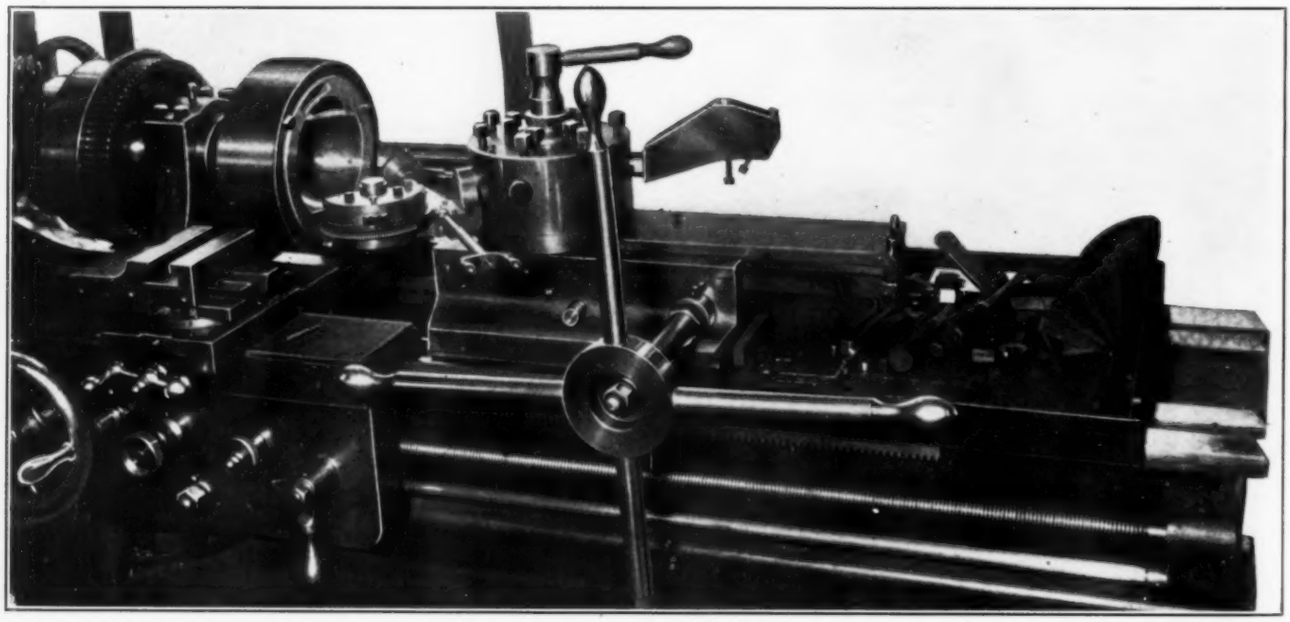


FIG. 6. SPECIAL TURRET TOOLS

motion of all of the turret tools. There is an automatic stop that trips at the end of the circular or sweeping cut that machines the spherical surface *F*. The pull catch shown in front of the slide throws the feed into mesh. Another interesting feature is the use of compressed air to blow chips away from the cutting tools and thus keep the feeding mechanism clean. This air is piped through a rubber hose to the rear of the slide and blows all of the chips forward and away from the cutting tools. An air valve is shown just back of the end of the rubber hose, and a few inches back of that is a small vertical pin projecting upward from the slide. The relationship of this valve and pin is such that when the slide feeds forward the air valve is opened by the pin and the air enters the piece being machined and the chips are blown out. When the slide is moved backward, the pin, of course, disengages from the valve and a spring closes it, thus shutting off the air until it is needed again.

Both of these machines show ingenuity in design and execution and are remarkably successful in the production of the parts that they were built to machine.

These disk water meters are made in a wide range of sizes, and the two machines that we have just described machine only the rings for the small meters. An extension of the same general scheme of manufacture for larger sizes is worked out in special turret tools and fixtures for standard turret lathes. Fig. 6 shows one of these sweeping tools in the turret of a turret attachment for an engine lathe. As shown, the feeding worm wheel is out of mesh with the feeding worm, but both can be seen plainly. Tools for turning the spherical surface are carried in a revolving tool holder driven by power. The combination of roughing and finishing tools is shown so plainly as to need no special description. In the rear of the turret is seen a tool holder carrying two tools for finishing the surfaces *D* and *G*, as indicated in Fig. 3.

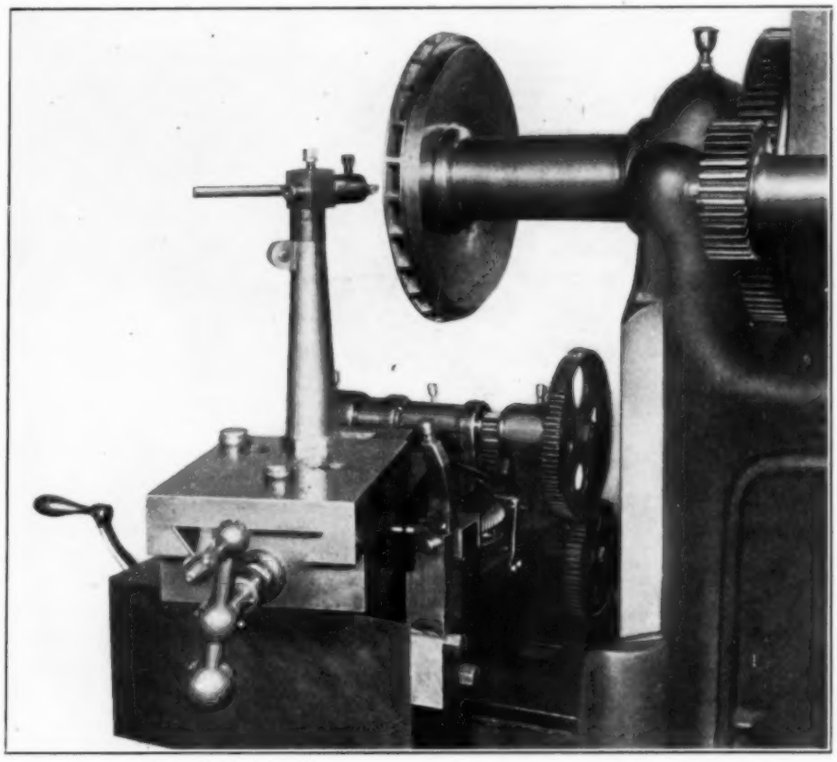


FIG. 8. ANOTHER VIEW OF THE MILLING M ACHINE ARRANGED FOR TURNING

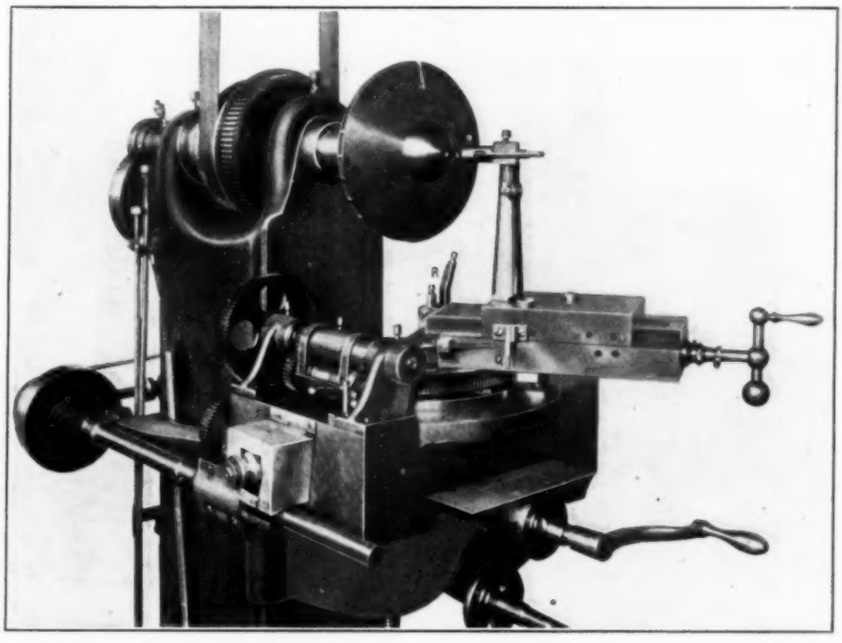


FIG. 7. A MILLING MACHINE ARRANGED FOR FORMED TURNING

This machine affords an interesting example of special turret tools adapted to a standard machine tool.

A Milling Machine Used for Turning

Figs. 7 and 8 show a standard milling machine fitted with special attachments to turn the disks of large disk meters. It is a peculiarly interesting development of the adaptation of a machine tool for special work. Upon the knee slide is fixed a worm wheel carrying a slide, upon which is mounted the tool. This worm wheel is driven by a worm connected, through gearing, with the regular feed shaft of the milling machine. A lever shown near the worm throws it out of or into engagement with the worm wheel, and thus either stops or starts the feed. The knee has the usual vertical motion, operated by a handle. The knee slide has the usual motion, controlled by the handle seen in Fig. 7, and the slide mounted on the worm wheel is under the control of a ball handle.

This machine turns the balls, or spherical surfaces of the disk, the conical surfaces of the faces and the spherical surface of the edge. Its motions are limited by stops, so that after the machine is once set each cut is gaged automatically.

In Fig. 7 the cutting tool is set to turn the ball or spherical surface. The stop for this operation is indicated by the letter *Q*. The small lever that forms the stop by abutting against the end of the screw can be thrown up out of the way, to allow for other motions of the slide. In use this lever either comes in contact with the screw directly or else is set by means of a set block. The circular feed is used for this kind of turning. Stops for the other surfaces are indicated by the letter *R*.

Fig. 8 shows the set up for turning the

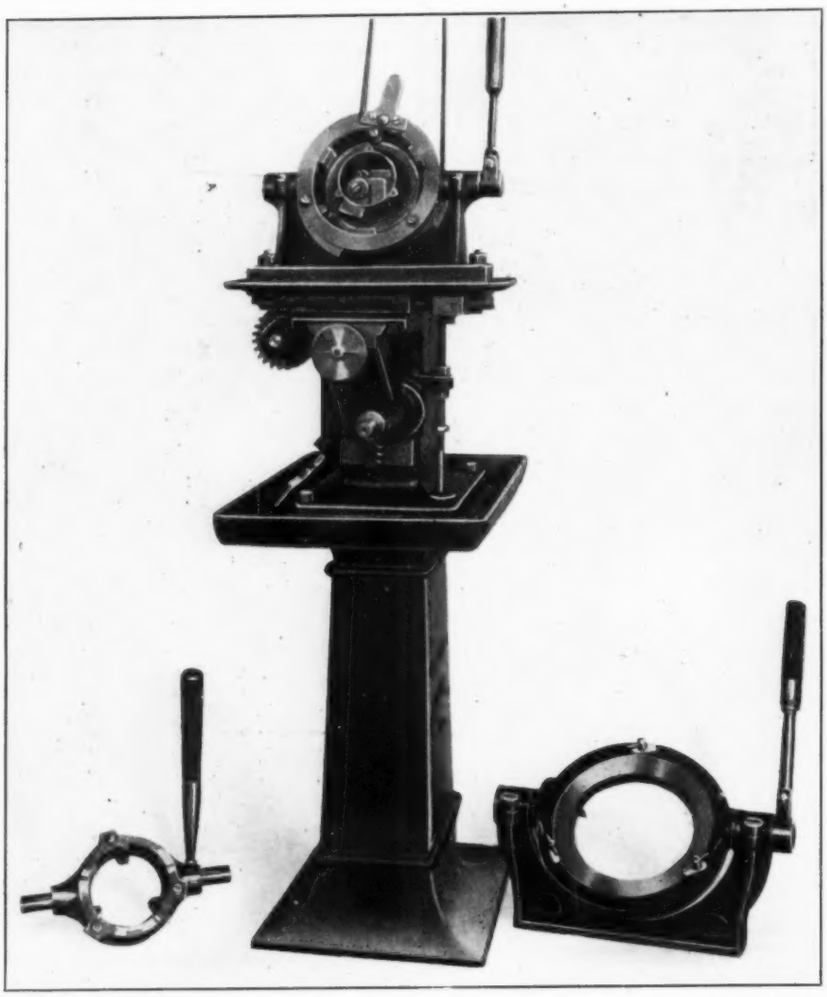


FIG. 9. HAND MILLER ARRANGED TO MILL A SPHERICAL SPLINE

wide conical surface on the face of the disk. The shorter of the two stops, indicated by the letter *R*, in Fig. 7, is used for this setting. Similarly the longer stop is used for a setting to turn the spherical surface of the edge. It should go without saying that if the tool-post slide is set to feed at right angles to the axis of the spindle a flat surface will be turned. Thus the machine is adapted for spherical, conical, cylindrical, or flat turning. In Fig. 8 two holes are shown behind the tool post, and near them covers that have been removed. These holes indicate additional locations for the tool post in order to adapt it for different sizes of disks. The knee slide is not limited by stops, but is set to micrometer dimensions as required. Taken all in all this is an ingenious development of a turning machine from an ordinary milling machine.

A Hand-miller Attachment

The rings of a disk meter, the turning operations of which have been described, have a spline cut in the spherical surface. The milling machine for this operation is shown by Fig. 9. To a hand miller a special spindle is adapted through gearing so that the milling saw revolves about an axis at right angles to the spindle axis. A work holder is hung on trunnions and operated by a handle, so that the work is swung past the cutter and the spline is cut. Various sizes of work holders adapt the machine to a wide range of rings. See the lower part of the half-tone, Fig. 9. The work-holding device of the attachment that is on the machine is worthy of notice. Three dogs are controlled by the rotating collar, and clamp and release the work by a movement of the short lever shown projecting from this ring directly above the center of the attachment.

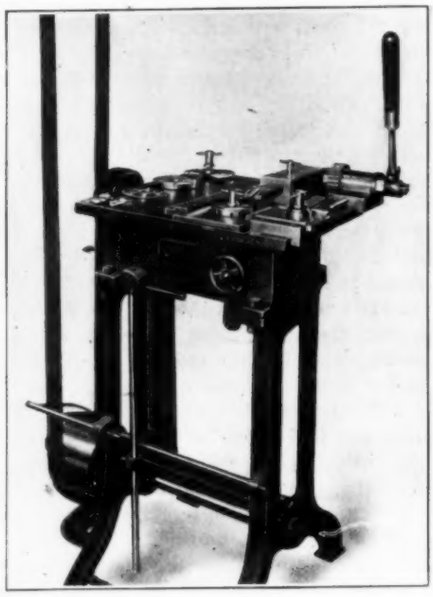


FIG. 10. A CIRCULAR SAW FOR BRONZE

A Circular Saw for Brass

Fig. 10 shows an ordinary small-sized cir-

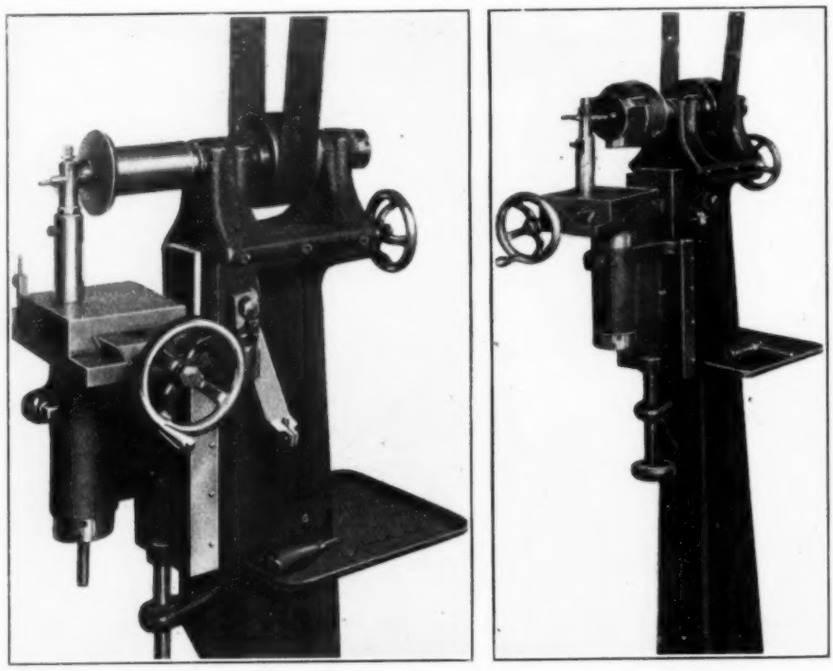


FIG. 11. TURNING MACHINE FOR HARD RUBBER

cular-saw bench arranged to saw up phosphor bronze disks that form the small pieces that enter the spherical spline, that we have

just described, and that are known as abutments. Looking along the left-hand edge of the saw table and beginning at the front, we see four abutments after they have been sawed from a disk, behind them a disk, and behind that two parts of the holder used for the sawing operation. Turning now to the right-hand edge of the machine a similar holder is shown in position. The feed of this holder into the saw is accomplished by means of a hand lever at the back right-hand corner. Its motion is controlled by a stop that can be seen parallel and near the rack that meshes with the pinion. These saw cuts are not radial, but are tangents to small center circles of the disk. Each disk requires eight saw cuts, four of which are tangents to a given center circle, and the other four tangents to still a different center circle. In order to get the two positions for these two sets of cuts, each holder is provided with two stop pins that determine the proper position. These two pins are shown on the slide at the front right-hand corner. Like most of the other machines of this plant, this saw is adapted for a wide range of similar disks.

FIG. 12. A SPECIAL FIXTURE FOR HAND MILLER

Hard-rubber Turning Machines

The two machines illustrated by Fig. 11 are used for turning hard-rubber disks of the disk meters, and in general principles, parallel the large milling machine that we have described. The machine at the right turns the outside of these disks; the machine at the left turns the inside. All of the motions are controlled by stops, so that the parts are automatically gaged; in fact this feature is typical of the design of the special machines and fixtures throughout the plant. The tools used for turning hard rubber are diamond tools. Two kinds are used, the black and the white. In general the black diamonds give better satisfaction, as they seem to be stronger and have better wearing qualities. Both of the machines show a diamond tool in position for a turning operation. These diamonds are set in either steel or phosphor bronze. Under normal conditions the diamond tool wears for about a year, after which period it is necessary to have it sharpened.

A Milling Fixture for Hard-rubber Disks

Fig. 12 shows a special milling fixture for milling a slot in hard-rubber disks. The photograph from which the half-tone was made was taken from the back of the fixture in order to show the clamping mechanism. The disk after turning is fitted over a conical seat and is held in place by the forked jaw, as shown. This jaw is pulled back against the disk by means of the latch *S*, projecting through the jaw, and this latch in turn is pulled back by a cam operated by the steel handle shown at the right of the fixture. The cutter used is a bevel mill. Two stops are provided, seen at the lower part of the fixture; these butt against the pieces *T* and *U*, and an oblique motion is also given to the fixture by the handle at the upper left-hand corner. The shape of the cut corresponds with the shape of the slot in the end of the strap that holds the work. The machine tool for which it is adapted will be recognized as a Burke hand miller.

A Useful Gear-cutter Arbor

A useful gear-cutter arbor adapted to a Dwight slate automatic gear cutter is illustrated by the half-tone, Fig. 13. The spindle of the indexing head has been removed and replaced by a special spindle that takes a draw-in bolt. A spare arbor and draw-in bolt are shown standing upright in the pan of the machine. The washer shown on the arbor bears against the outer end of the string of gear blanks. This arbor is rapid in manipulation, and is claimed to give gears that will run more true than those produced on the ordinary type of arbor used for this class of work.

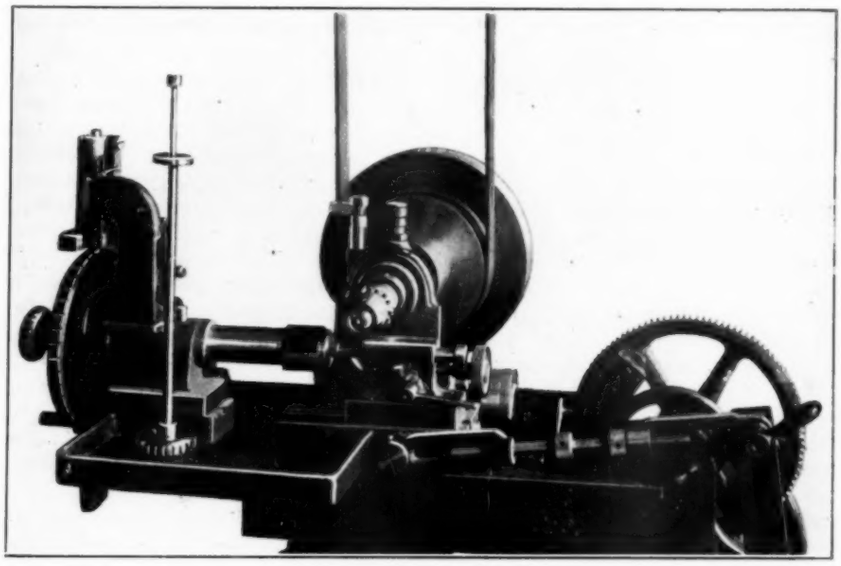


FIG. 13. AN AUTOMATIC GEAR CUTTER ARRANGED WITH A DRAW-IN BOLT

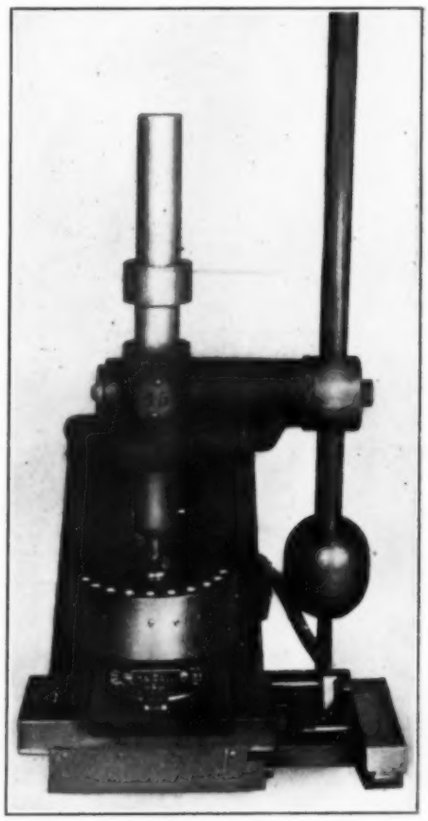


FIG. 14. AN ARBOR PRESS MADE INTO A NUMBERING MACHINE

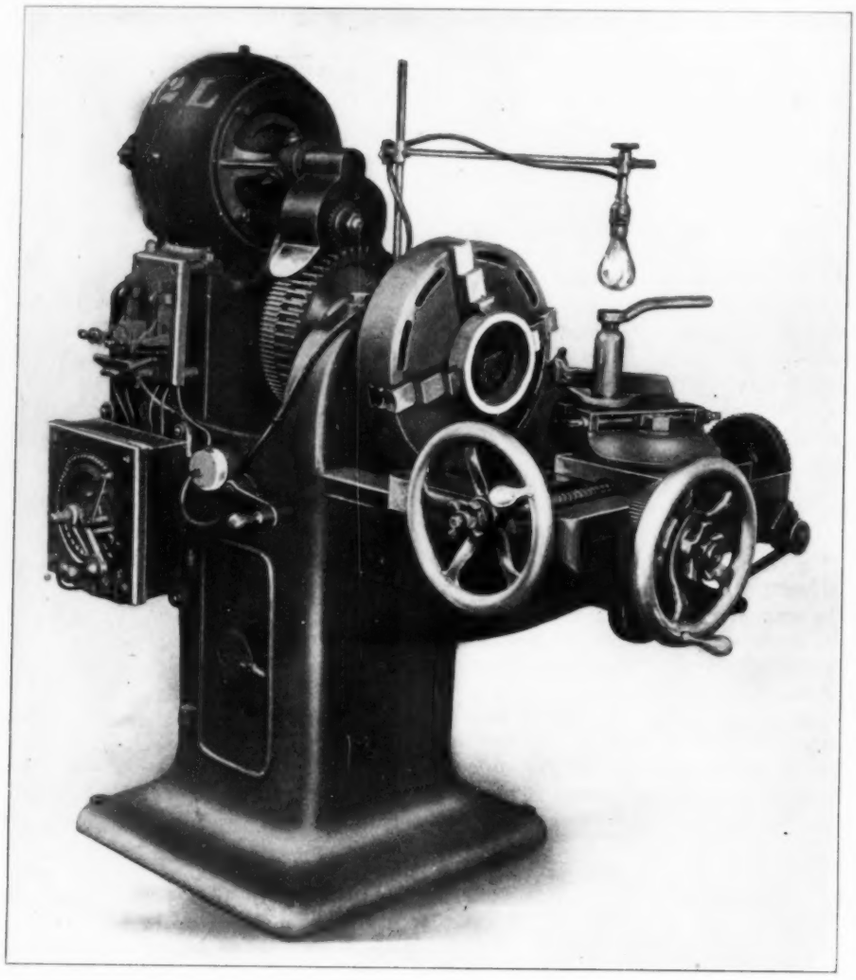
A Simple Semi-automatic Numbering Machine

An ingenious adaptation of a simple tool is illustrated by Fig. 14. Here an ordinary arbor press has been transformed into a semi-automatic numbering

machine. It is used for stamping the serial numbers on the brass name-plates of meters. At the base is a holder provided with a series of plates, each plate adapted to a particular style of name-plate. Above this holder is a cast-iron turret drilled near its outer circumference with a row of holes, each one of which contains a steel figure. These are under spring control, so that after they are forced down by the punch they will return to a normal position. The hand lever of the arbor press is weighted at its outer end so that this end will swing readily to its lowest position, and when in that position trip a catch of an automatic feeding device that feeds the carrier plate step by step. Thus, when the machine is in use, the operator swings the turret containing the numbers with his left hand to register as he wishes and operates the lever which stamps the number and feeds the plate with his right. For the purpose intended this machine is as serviceable as would be a more elaborate numbering machine, and shows again how ordinary or standard tools can be adapted with a little careful planning for work, which would be considered ordinarily in a class to be handled successfully only by a complicated machine, or tool.

A Pedestal Lathe

The manufacture of dies such as are used for cutting and forming sheet metal requires heavy face-plate lathes for turning the steel rings, which are an important part of such dies. As the machine-tool builders did not seem to have machines particularly adapted for this work, some time ago Oberlin Smith, the president and mechanical engineer of the Ferracute Machine Company, of Bridgeton, N. J., designed and had built a number of lathes to fill the needs of his company, which makes a specialty of presses and dies for sheet metals. These are shown in the accompanying illustration. The frame is a single casting, made heavier than is usual for a swing of 20 inches, the head being 4 inches thick, and solid, with the other sections proportionately strong. The result is a compact machine, built on the "anvil" principle, enabling the operator to take unusually heavy cuts without the chatter incident to lightly built machine tools.



A SPECIAL PEDESTAL LATHE FOR DIE WORK

A pulley is attached to the left-hand end of the spindle, and is belted to a small, splined shaft on the farther side of the lathe. This shaft is geared to a similar shaft, both containing sliding countersunk keys. Each shaft contains three small gears having diameters of 1 13/16, 2 13/16 and 3½ inches, respectively. The sliding keys are given motion by the crank handle that appears just above the pedestal door in the engraving. Each gear contains a spring feather which is prevented from acting by the sliding key, and connects the gear to the shaft only when the countersink in the sliding key comes opposite the feather. When the crank handle is in the position shown in the illustration, there is no motion given the feed shaft, because the gears are revolving loosely on their shafts, but raising or lowering the handle gives revolution in one direction or its opposite, the amount of motion being dependent on the distance the handle is lifted or depressed. The feed shaft is belted to the lateral feed, the cross-feed being driven by a worm on the feed shaft. The cross-feed screw is hollow, there being a friction cone on its farther end controlled by a hand nut on the front end of the feed screw. The lateral feed also contains a friction cone similarly operated.

These lathes have been used for a number of years and been found admirably adapted for the special work for which they were built. They were originally provided with ordinary cone pulleys belted from countershafts, but these have more recently been replaced by continuous-current General Electric 2-horsepower motors. Each lathe contains a controlling rheostat and a circuit breaker. There are 25 speeds on the rheostat which, with the variation of speed caused by throwing in the back gearing, enables the operator to obtain any speed required.

A counting machine that is reported to be an improvement over anything of the kind yet produced, the invention of a Swedish engineer, was recently installed in the Counting House of the Bank of England for experimental purposes, and its performance was highly successful in point of rapidity. The machine is operated by electricity and is capable of counting up and sorting money into paper bags or tubes at the phenomenal rate of 72,000 coins an hour. The coins are placed in a receptacle at the back of the machine and by mechanical means are sorted, stacked and inserted into paper tubes in high record time.

In a discussion presented before the A. S. M. E. semi-annual meeting it was stated that strips of seven materials, mounted on a board and subjected to the uniform action of a sand blast for 45 minutes show the following relative abrasive-resisting qualities, rubber belting being taken as the standard: Rubber belt, 1; rolled-steel bar, 0.66; cast iron, 0.28; balata belt, including gum cover, 0.2; woven cotton belt, high grade, 0.16; stitched duck, high grade, 0.13; woven cotton belt, low grade, 0.06 to 0.11.

Metal Cutting Tools Without Clearance*

A Radical and Remarkable Departure in the Form of and Practice with Cutting Tools Introducing Unexampled Keenness of Cutting Angle

BY JAMES HARTNESS

This paper sets forth a turning tool that is intended to cut without clearance.

It consists of a cutter and a holder so constructed as to allow the cutter a slight oscillatory freedom in the holder.

The center line on which the cutter oscillates is substantially coincident with the cutting edge.

The oscillation of the cutter about the center line does not affect the position of the edge, but it does allow the face of the cutter to swing around to conform to the face of the metal from which the chip is being severed.

The objects of this construction are to make possible the use of more acute cutting edges to reduce the cutting stresses; to wholly or partly equalize the unbalanced side pressure on the cutting edge, and to obtain a rubbing contact to prevent lateral quivering.

In order to bring out these objects it is necessary to briefly analyze some of the conditions under which metal is worked in a lathe, dealing particularly with cutting angles, clearance of cutting edges and the importance of minimizing the tendency of the work and tool to separate under cutting stresses.

No attempt is made to discuss the forms of cutting edges for withstanding the heat of high-speed service. High-speed tool forms have been ably and perhaps conclusively treated in the paper by Fred W. Taylor and its discussion, and the papers of Doctor Nicholson before this society and the Manchester Association of Engineers.

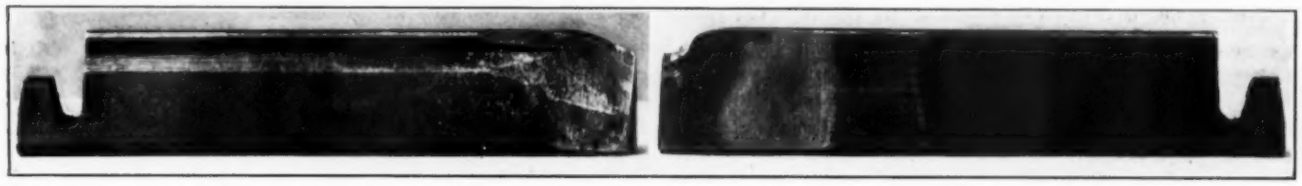
The generally accepted cutting angle of greatest endurance under high speed is about 75 degrees, and the angle of least resistance, according to some of Doctor Nicholson's tests, is about 60 degrees, with an increase *below* as well as above that angle.

The cutting angles of the tool described in the present paper may be varied from the present orthodox angles down to 30 degrees or less, according to the nature of the work.

The results obtained by Doctor Nicholson, which showed an increase in cutting stress for tools more acute than 60 degrees, may have been due to the cuts having been run without cutting oil or suitable cutting lubricant. Furthermore, the comparative lack of durability of the more acute edge below 70 degrees may have been due either to heat or lateral quivering or both. The heat would have been greatly reduced by a liquid cooling medium, especially one having some suitable lubricating qualities, and the lateral quivering may now be eliminated by means explained in this paper. The thin edge of an acute tool is obviously the least suited to carry off heat or to withstand the quivering incident to cutting.

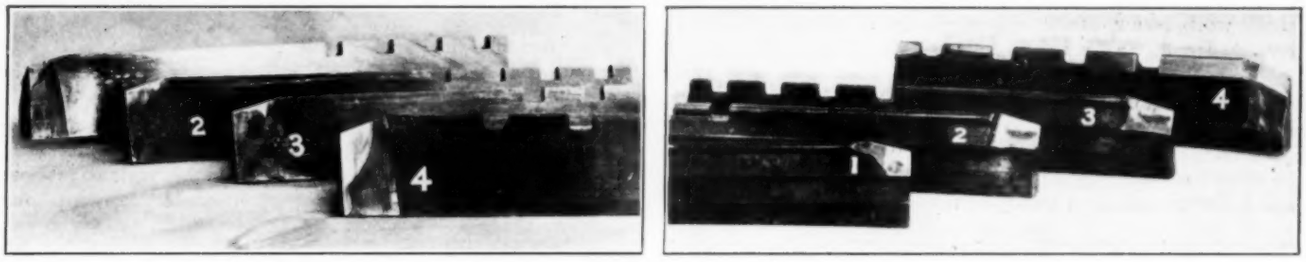
Having mentioned the great work of Mr. Taylor and co-workers and of Doctor Nicholson, it is necessary at once to disclaim any pretention at contributing valuable data, such as found in the papers of these truly scientific researches. Nothing of the kind is possible at this time. All that is attempted is to suggest a scheme for widening the field of investigation.

Instead of approaching the subject as a scientist bent on getting exact data regarding performance of certain existing forms of tools and machines, the writer's line of approach has been from the standpoint of a designer and manufacturer of lathes, and particularly lathes of the character of the flat turret lathe.



NO CLEARANCE TOOL—HALF SIZE

Showing an equal abrasive effect on each edge. View at the left shows the top slope, the angle of which was increased by chip abrasion.
View at the right shows the abrasive effect of the shoulder of the work which reduced the cutting angle, but not as much as the abrasion of the chip increased it.



CUTTERS USED IN THE FLAT TURRET LATHE

Each tool bears the same number in both cuts.

Showing the abrasive contact of chip on the top slope. Nos. 1, 2 and 3 were used in the turner illustrated. No. 4 shows one of the earlier forms.

Showing the rubbing contact of the tool against the shoulder of the work.

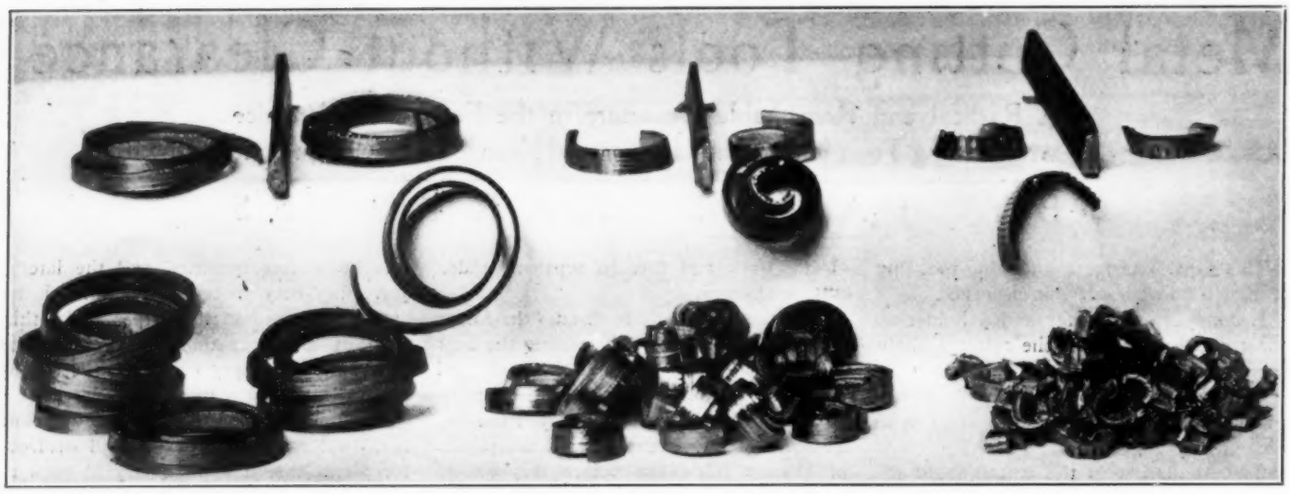
The Class of Work Here Considered

The means for cutting set forth should be considered from the standpoint of one who sees nothing but lathe work under 20 inches in diameter, and of the kind usually found in any machinery-building plant, whether it is a navy yard, railroad shop, or automobile-building plant; not that the means may not be of value in larger work, but simply that this is out of the writer's range of experience, and such work was

*A paper read at the New York meeting of the American Society of Mechanical Engineers.

References mentioned: Dr. J. T. Nicholson's papers in *Transactions* of Manchester Association of Engineers, 1903, and in *Proceedings* of this society, page 687, volume 25, 1904.

Fred W. Taylor's paper, Volume 28, 1906; also cuts on page 333 in Dr. Nicholson's discussion of Mr. Taylor's paper.



SAMPLES OF CHIPS AND CUTTERS

Cutting angles from left to right 45 degrees, 60 degrees and 75 degrees. These chips were produced in an engine lathe. The chips were confined edgewise between the body of work and the end of the holder. The breakage of chips taken by the 45-degree tool was due to chip getting caught between the work and tool holder, due to the irregular winding of the chip. The chips produced by the 60-degree tool wound up till the circle was greater than the chip would take without breakage.

not considered in designing the tools described.

A more exact description of the range of work for which this tool is intended may be: Lathe and turret-lathe work under 20 and over 4 or 5 inches in diameter and less than 8 or 10 inches in length; also work up to 2 and 3 feet in length of diameters under 3 to 3½ inches and generally over ¾ or 1 inch in diameter.

It includes three classes of work: *a*, chuck work, having diameter generally exceeding length, and which is held wholly by a chuck or face plate; *b*, bar work, which is held in a chuck and steadied by back rests; and *c*, work having dimensions similar to bar work, but which must be turned on center points, with or without following and fixed steady rests.

It will be noticed that this excludes all of that kind of larger and heavier lathe work in which the principal duty of the lathe is the rapid removal of the stock. In this particular branch of work under consideration the rapid removal of stock is important, but not paramount.

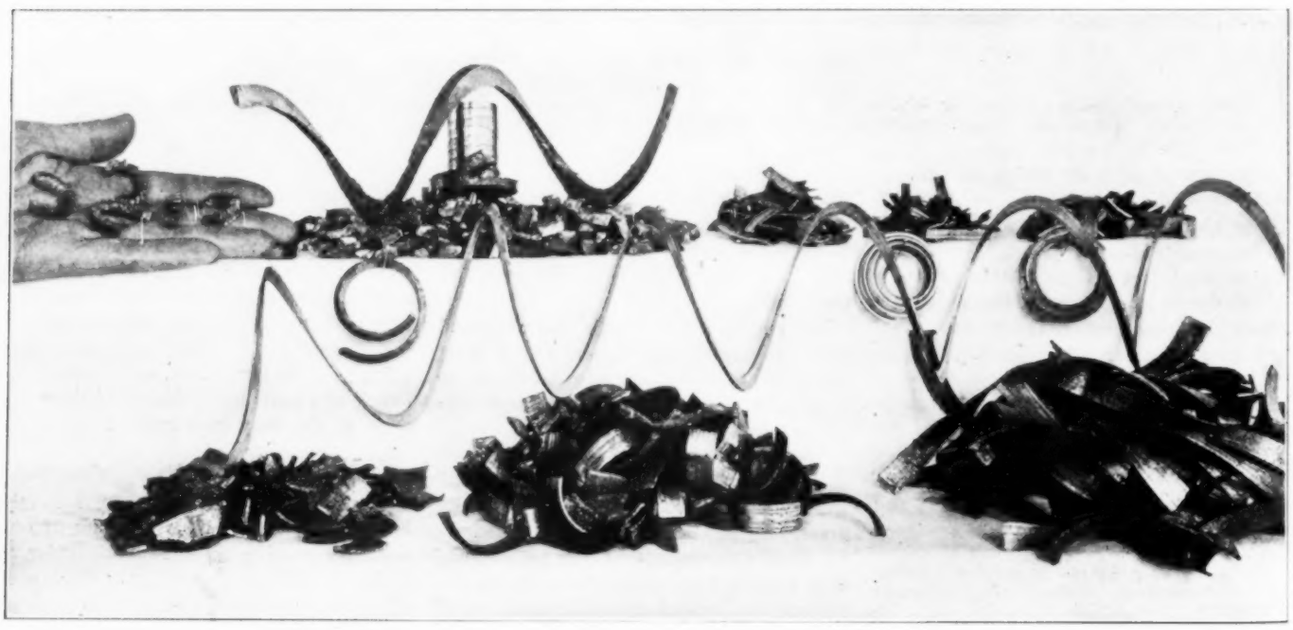
Although the field of work includes all kinds of steel and cast iron, this paper will deal only with the standard open-hearth machinery steel of about 20 points carbon.

In work supported on centers and in chucking work the connection between the work and tool includes a number of joints, both for sliding the tool in relation to the work, and for the rotation of the work. Each of these joints has more or less slackness, and each of the slides and other members are more or less frail in structure. With a mounting of this kind the cutting edge of the tool does not pass through the metal without swerving and flinching.

Means for Improving Efficiency

A machine's efficiency is proportional to its strength to resist its working stresses. There are two ways to increase this efficiency: *a*, by strengthening the machine, and, *b*, by reducing the stresses for a given result.

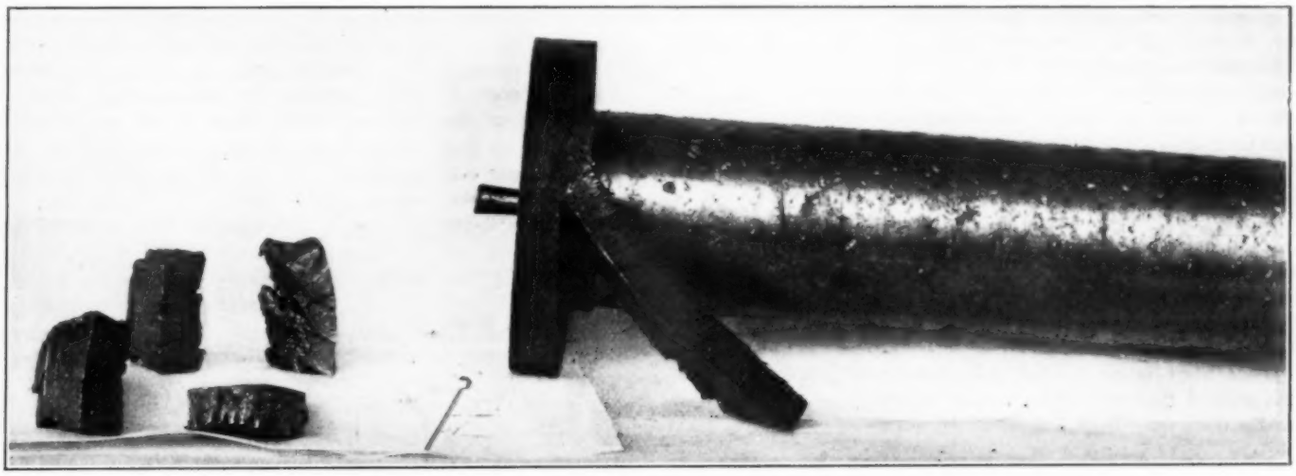
In the writer's previous work the strengthening of the machine has been accomplished by the elimination of unnecessary features, and placing the necessary joints for obtaining the various motions in the least objectionable positions. But



SAMPLES OF CHIPS

Those in the hand were produced by blunt side tool having 75 degrees cutting angle, all other chips were produced by tools having cutting angles of 45 degrees or less.

The chips in the three small piles at the right on the top row and those on the lower row were broken by a chip controller. These chips were produced by cutters Nos. 2 and 3, at 45 feet per minute peripheral speed and 22 feed per inch; depth of cut 7/16 inch, reducing from 1¾ inch to ⅞ inch.



SAMPLE OF BROKEN CHIPS AND WORK, WITH AN UNBROKEN CHIP

This view is a little larger than the sample; the exact dimensions were 1¾ inches down to 1 inch in diameter. The feed was about 7 per inch; cutting angle of tool about 38 degrees; extreme edge 1/32 inch flat.

since this has been so fully outlined in the semi-commercial treatise entitled "Evolution of the Machine Shop," it is unnecessary to make further reference to the special forms of design therein set forth, excepting to say that a single-slide scheme of lathe design was adopted to eliminate the complicated and frail construction of the multi-slide tool carriage which is now in almost universal use in all standard machine tools.

The next step was to devise a means for minimizing the stresses at the cutting edge, and the object of the present paper is to explain how this result has been obtained.

This reduction of stresses may not be important in roughing work in which a flinching of the work or machine may be disregarded so long as the machine continues to crush off the metal, but for the kind of work mentioned in this paper it has been considered of first importance.

Analysis of Conditions

In the class of work under consideration each piece has several diameters, with shoulders which should be accurately spaced and formed. Nearly all the shoulders required in this class of lathe work are the so-called square shoulders.

In engine lathe practice these shoulders are "squared up" by a side tool after the other turning has been done by a round-nose or diamond-point tool, but in the turret lathe for bar work these shoulders are produced by the same tool that takes the stock removing cut.

The tool used in turners for bar work cuts on the same principle as the engine-lathe side tool; that is, its rake or top slope is almost wholly side slope, and its cutting edge stands at an angle of 90 degrees to the axis of the work.

In the engine lathe a tool of this character has generally been unsatisfactory for rapid turning, yet in the turret lathe this very tool seems to be universally used for all bar work. The difference in performance seems to be due to the difference in mounting. It works well where there is no chance of vibration, but trouble begins when it is used in a machine like the engine lathe or turret chucking lathe in which the work is supported by one part of the machine and the tool by another, and the true path of the cutting tool through the metal is dependent on the entire structure of the machine, there being nothing to prevent quivering.

The no-clearance tool to be described is a side tool without clearance. Its under face bears against the work, thereby preventing the lateral quivering which has previously made this type of tool inefficient.

Cutting Stress

Direct Cutting Stress—For the purpose of analysis the cutting stress may be divided into three elements; the direct cutting stress, the separating stress, and the tendency to quiver, which we will consider in turn.

By direct cutting stress we mean that part of the stress that is directly downward in a lathe. With all other conditions unchanged, we should expect to find an acute edge tool offering the least resistance, and that the difference in direct cutting stresses for tools of varying cut-

Chips taken by diamond-point tool—75 degrees top slope and slightly rounded nose.

Chip taken by 40 degrees no-clearance tool at same feed and depth.

Illustration is enlarged to about double size.

ting angles would show a marked reduction in favor of the more acute tools.

Doctor Nicholson's experiments already mentioned below 60 degrees showed an increase in cutting stresses and a marked loss in endurance, but these tests were on dry cutting without the benefit of a lubricant or cooling solution. The thin-edge tool is undoubtedly benefited more by lubricant or cutting medium than blunt-edge tools. Just what cutting angle would be the best under conditions of most efficient cooling medium may not yet be fully known.

That there is no marked difference in the blunter tool of varying cutting angles really does not affect the situation when we try the real cutting or sliding angles, which may be roughly stated to be efficient in proportion to their acuteness.

It is obvious that the least direct cutting stress for a given depth and feed should be obtained by a straight-edge tool, and one that would take a chip in which there is the least molecular change.

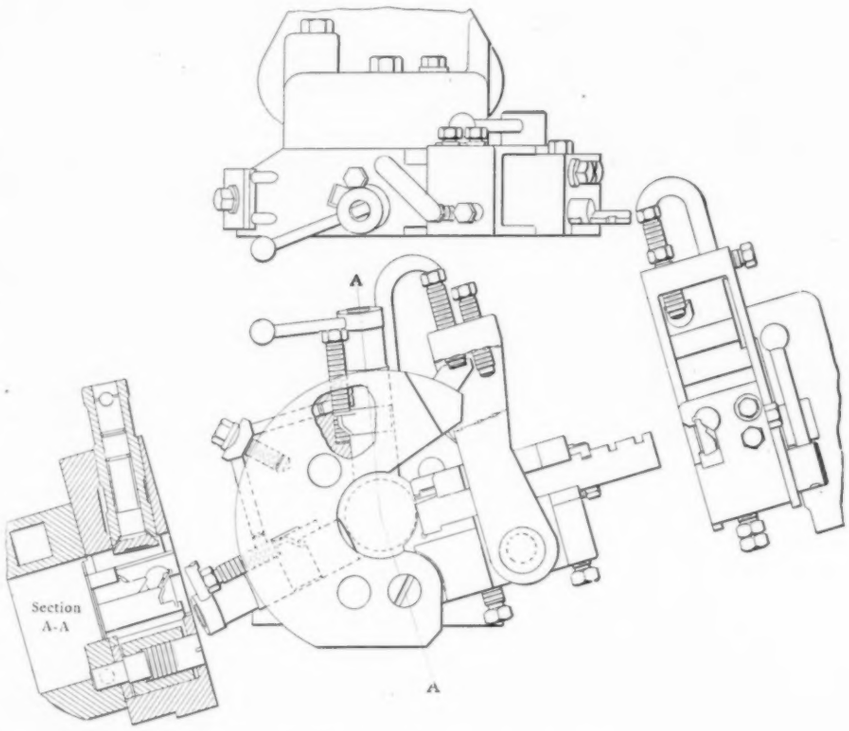
Crushing and partially or wholly shearing the chip into chunks which are three or four times the thickness of the feed undoubtedly increase the working stresses and heat.

The cuts accompanying Doctor Nicholson's discussion, page 33, Volume 28 of *Transactions, clearly* illustrate the great distortion that takes place even in cutting with an accurate tool of 60 degrees and a straight-edge. This tool does not have even the disturbing element of shearing action at the edge of the chip. This experiment shows the distortion of nearly every part of the chip. A tool having a round nose or a blunt edge would doubtless show still greater distortion.

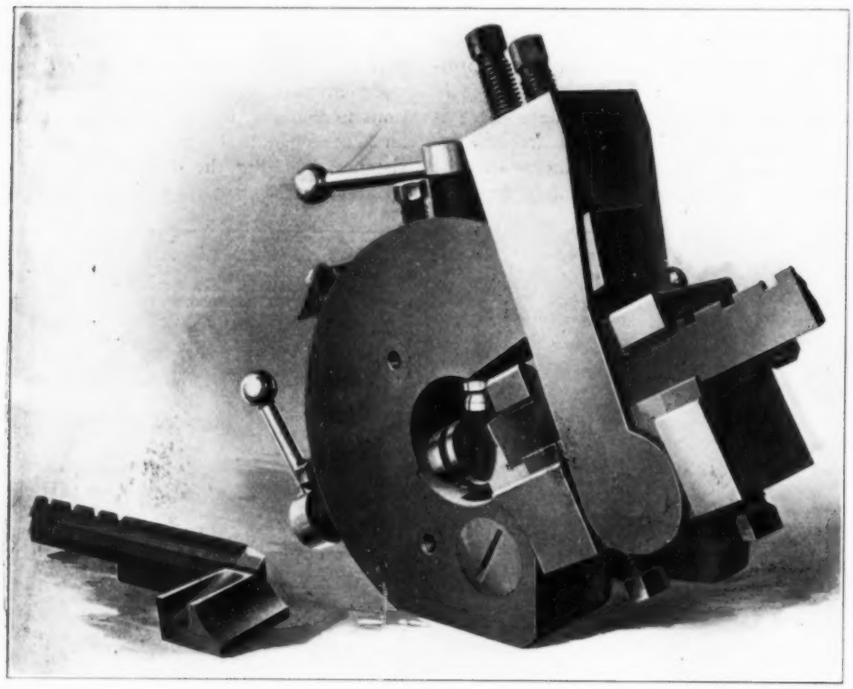
A flat-top slope should have a straight cutting edge. The more the edge is rounded the greater the conflict of the metal crowding onto the edge. The flow of metal on the top slope of the round nose does not move in one direction wholly, but tends to travel toward the center of the curve. The conflict of currents of metal which approach the center from various parts of the curved cutting edge increases the direct cutting stress.

The crushing process of the present scheme of turning is due both to the bluntness of the cutting angle and the shape of the edge.

A curved edge should have a curved-top slope in order to remove the chip with the least distortion of the metal. The curved-top slope for this purpose would make the shape of the cutting edge similar to the cutting edge of a carpenter's round-nosed chisel. This form of tool is not offered as a practical form, but is mentioned to emphasize the unnatural flow of the chip that must take place on the flat-top slope of a round-nose tool.



TURNING TOOL USED ON THE FLAT TURRET LATHE



LARGER VIEW OF CUTTER AND CHIP CONTROLLER

THE NO-CLEARANCE TURNING TOOL FOR THE FLAT TURRET LATHE

This tool is provided with a double adjustment by which it may be set to turn two sizes. See accompanying line engravings.

Separating Stress—By separating stress we mean that stress which, in turning a shaft, forces the tool outward radially. Increasing this stress causes the work and tool to move apart, and results in variation in diameter, also in irregular and generally inaccurate product, particularly when the rough stock runs eccentric or irregular.

Although this separating stress may be lessened by giving the tool more back slope, this is only possible in tools taking light depth cuts. A lathe tool, however, which takes a cut like a side tool gives little or no tendency to separate radially.

With the side tool set at an angle of 90 degrees to the travel of the feed, the feeding stress does not tend to force the work and tool apart; in fact, this tool may be set so as to produce a slightly beveled shoulder either side of the 90 de-

grees so as to either draw the work and tool together when making an overhanging shoulder, or to force the work and tool apart when producing an external bevel.

Quivering Stress—The quivering stress which is due to the nature of the chip is affected by the cutting angle of the tool. The chunks which make up the parts of a chip are less firmly united in a chip taken by a tool of 70 degrees cutting angle than by a tool of 50 degrees, and, of course, the more firmly united chunks give a more continuous chip with the least vibration of stresses.

In turret-lathe practice, especially in bar work, the tool and work are held together by a back rest which follows on the surface produced by the cutter, and in some kinds of turret-chucking work the tools for interior work are mounted on boring bars which take bearing either in the work, or in the chuck which holds the work. When tools get this steadying support directly on or in the work, they are freed from the chattering due to the machine mounting, but not free from that due to their own frailty, or to the intermittent flow of the chip as it is taken off in chunks.

Relative Destructive Effect of Heat and Lateral Quivering

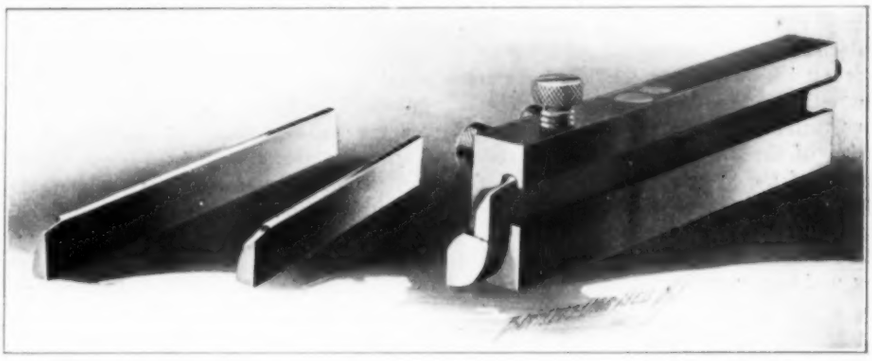
The writer is not unmindful of the effect of heat in the destruction of the cutting edge, and fully realizes that no perfection of mounting of the work and tools will prevent destruction of the cutting edge of the tool by heat, but wishes to bring out the importance of the destructive effect of chattering which is ever present in standard types of machine tools. Heat is undoubtedly most destructive when roughing at high speeds, but the quivering plays a very important, if not the greatest part in edge destruction when finishing at the usual speeds.

Many machines are not run up to the high-speed limit of the cutters. Even when provided with ample driving power, the strenuous life of attending a high-speed machine is a little too much for the average man. As the speed is reduced, the quivering gains in relative importance, which should be taken into account in considering the no-clearance tool. With the slower speeds tools should be used that give the best results at slow speeds.

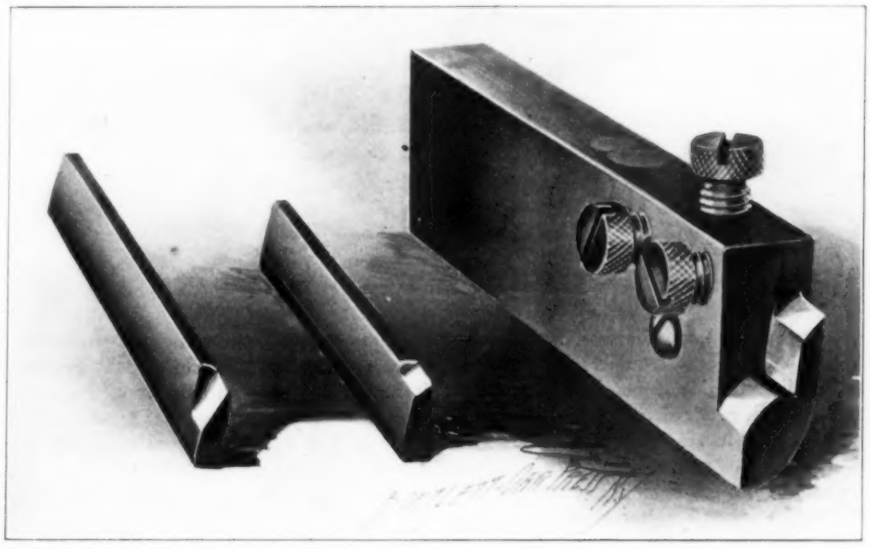
Other Considerations

The failure of the keen edge under normal cutting conditions, and its surprising endurance under some abnormal conditions, seemed to indicate great possibilities open to any scheme that would maintain the best conditions. For instance, we have seen the edge of a diamond point broken off by an ordinarily heavy chip at one time, and at another time we have seen a similar tool deeply imbedded into the metal without breakage, the tool having taken a plunge and lifted or plowed up a chip of enormous proportions *without breaking the tool*. Every lathe hand has seen this performance. Usually it ends with breaking the tool or the center of the lathe, or both, but occasionally the lathe is stopped without breakage; then the lathe hand by great care may separate the work and tool without breaking the edge. The immense chip plowed up by a frail tool demonstrates what a cutting tool can do under some conditions.

We are also aware that under some conditions a cutting tool will actually sharpen itself in the process of cutting, yet neither of these results is regularly maintained. They suggested, however, the possibility of supplying a means by which they could be maintained in regular work.



NO-CLEARANCE TOOL FOR STANDARD ENGINE LATHE TOOL POST—SHOWING THREE CUTTERS OF DIFFERENT ANGLES



NO-CLEARANCE TOOL FOR STANDARD ENGINE LATHE TOOL POST—SHOWING THREE CUTTERS OF DIFFERENT ANGLES

Clearance

Since the birth of the slide-rest lathe in which the tool was first guided by mechanism, turning tools have been given clearance and it has been assumed that they would not cut without clearance.

Of course, it is well known that the orthodox lathe tool goes out of commission after losing its clearance, but that does not demonstrate that a tool cannot cut without clearance. It only proves that the present tools require clearance as they are now formed and mounted.

A tool which has been ground for clearance and set in such a position that its under face is at an angle to the shoulder produced, presents but a small area to the shoulder of work when the clearance of the extreme edge has given way. The area is so small, compared with the stress of the abrading metal passing it, that it rapidly scores and wears into a rough surface standing at a "negative" clearance angle. A tool with a negative clearance and rough surface quickly goes from bad to worse.

The tool which has been set by chance in an engine lathe so that a comparatively large area of the under face rides on the wall of metal does not wear away, because its surface is not subjected to as great abrading pressure per unit of area. Its area is sufficient to withstand abrasion.

It was assumed by the writer that increasing the contact of the under face of the tool against the face of the work would make it possible to cut without clearance.

The advantage of a no-clearance tool is that its face rides on a good area and supports the under edge against the pressure of the chip, thus relieving the edge from the one-sided pressure which must be borne by a tool having clearance. This one-sided pressure may be wholly or only partly relieved.

Of course, in all of the former types of tools the cutting edge must withstand the stress that is wholly one-sided, excepting for the occasional condition stated in which a cutting tool obtained by chance a bearing on its clearance face.

No-clearance Tool

In order to enable the tool to ride flatly against the wall of metal from which the chip is being removed, we have mounted it to allow a comparatively free swiveling action on a center line that is substantially coincident with the cutting edge of the tool. When the tool is so mounted the pressure of the chip on the top slope tends to throw the so-called clearance face against the shoulder, for the mounting allows the tool to swing around to any angle that may be necessary to fit any work form, from a straight surface in planer work and the nearly straight surface in work of large diameter down to the angle of a helix obtained by the coarse feed on work of relatively small diameter.

A tool so mounted either swings automatically to adapt itself to angularity of feed, or may be swung by hand as soon as the cut is started. Its natural tendency holds it snugly against the metal, but the force may be varied from one that equalizes the stress on each side of cutting edge down to a very slight stress which only holds the tool in no-clearance position.

An important feature is that the tool is free to swing around to offset the unequal wear on the "clearance" face.

As previously stated, a fixed cutting tool with a slight clearance soon loses its clearance, and from that step to the point where it gets a negative clearance there is generally but a short space of time.

The swivel mounting of the tool allows the cutter to swing around to take care of not only the feed, but the changing surface of the tool due to wearing action.

In the early experiments cutters were used which were clamped rigidly in a holder, which in turn was pivotally mounted on a fixed holder. The cutting edge of the tool was so located as to stand exactly on the center line of the swiveling holder.

In the later experiments the scheme has been simplified by loosely mounting the cutter itself, providing it with a round bottom struck from a center line which is near the cutting corner of the tool. The cutting edge is usually standing at an angle to its center line of swivel, giving the tool a front slope. The scheme of inclining the cutting edge to the line of swivel was adopted for the purpose of using a bar-shaped tool in which its shape could be maintained by grinding, for with this shape grinding back the end provides for the wearing down of the top edge. This gives the tool a front slope when the swiveling center is kept horizontal. In some cases it may be well to tilt the holder to an angle that brings the cutting edge horizontal.

This departure from the ideal center position of the line of swivel is not sufficient to cause any trouble. In fact, the pivotal line need not be exactly parallel to the cutting edge, neither is it necessary to have it very near the center line of swivel. It is probable that, under some conditions, the cutting edge may advantageously be located either above or below or on either side of the cutting edge. The exact location of the cutting edge relative to the center of oscillation partly determines the pressure with which the tool rides against the wall of metal from which the chip is taken.

The extreme top edge of the tool, in some instances, has been slightly flatted on the acuter angles, the flat measuring from about one sixty-fourth to one thirty-second inch, and standing either 90 degrees from so-called clearance face or sloping in either direction. Very good results were obtained by giving it a negative side slope standing at a maximum angle of from 10 degrees to 15 degrees from horizontal. This top flat seems to make a good resting place for the false edge, and it may be that its successful operation is dependent on the false edge.

One interesting phase of these experiments has been the comparative willingness on the part of the tool to relieve the carriage of the duty of feeding. This first became apparent when the carriage continued to advance after the feed had been "thrown out."

This self-feeding feature, of course, cannot apply to the action of planers, boring mills, or work of large diameter. It is mentioned here only to indicate the absence of resistance to the feeding motion under some conditions.

The ultimate outcome of the use of acute-angle tools may lead to allowing each tool taking a heavy cut on small diameters to determine its own feed. In the turret lathe this would be a distinct advantage.

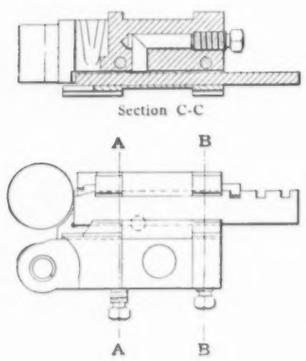
Chip Lifter and Chip Control

The chip produced by the acute-angle tools possesses great lateral strength. The continuous chip is preferred by any operator who has had experience with hot chips which are thrown off by the tools of blunter angles, but while this particular feature enables him to closely observe the action of the tool without risk, the continuous chip in itself becomes troublesome, if allowed to run too long without breaking.

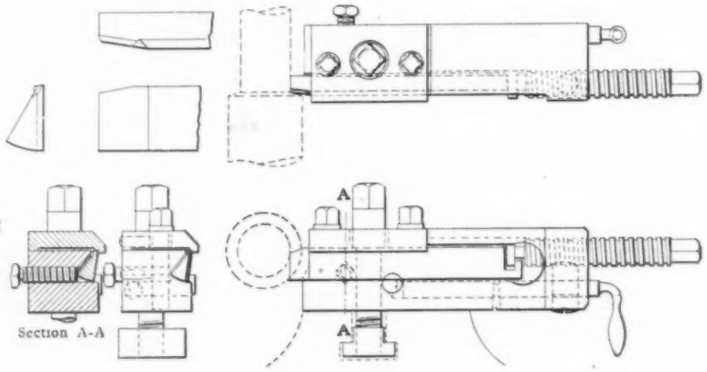
In some of the first experiments with this tool, chips having a depth of about three-eighths of an inch, and produced by a feed of six to the inch, were found exceedingly troublesome, especially when allowed to run out to lengths of five to fifteen feet.

The lateral stiffness of the chip of the more acute tool made it possible to increase the tearing open or splitting effect which has been mentioned.

In order to increase the tearing action of the chip it is necessary to allow the chip, after it has passed from the edge of the tool, to pass over a lifter in the form of a wedge, either formed integral with the tool or placed in the path of the chip near the tool, having an angle that not only assists in tearing the metal ahead of the tool, but will also relieve the slope of



MEANS FOR CONTROLLING CUTTER IN FLAT TURRET LATHE



NO-CLEARANCE TOOL APPLIED TO AN ENGINE LATHE

the tool near the edge from an important part of the labor.

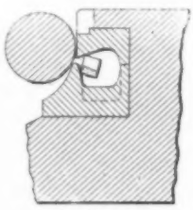
In other words, a chip possessing lateral strength made it possible to carry an important part of the cutting or splitting action farther away from the extreme edge. The heat generated by this part of the work, of course, being where it is, in no way reduces the life of the extreme cutting edge.

Although this chip-lifting effect may be produced by a top slope having a curved surface, it has seemed best for the convenience of grinding the tool on an ordinary wheel to keep the top slope of the cutter a flat surface, and introduce this chip lifter as a separate member, either a part of the tool holder or in conjunction with chip breaker to be hereinafter described.

Experiments with the chip-lifting scheme seem to be in harmony with the evidence shown by the self-sharpening tool

Even with the blunt tools, the curling chips which are sometimes used to illustrate ideal working conditions of a machine require constant attention of the operator, and either a very large receptacle which doubles the floor space required for the machine, or the almost constant attendance of an extra man for removing the chips from the room.

The use of the more acute angles increases the chip trouble, and may in some instances make it advisable to retain the



Section B-B

has preferred to use a chip breaker which depended on depressing the chip after it passed over the chip-lifting incline. A breaker of this kind breaks the chip in lengths varying from one-half to three inches.

Conclusions

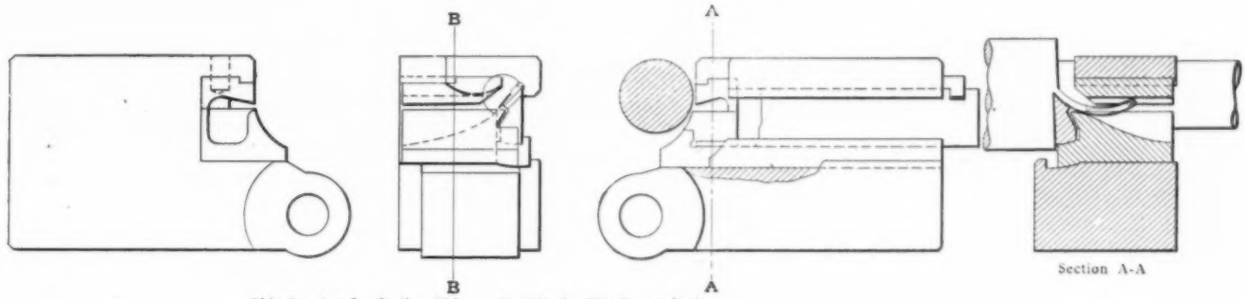
The no-clearance cutter relieves the edge from the one-sided pressure.

It prolongs the life of the cutter by allowing abrasion on its face without producing negative clearance.

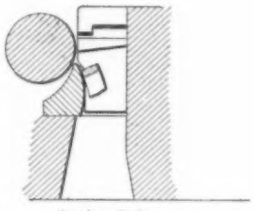
It prevents lateral quivering.

It converts the lip angle into a cutting angle which for a tool of given form constitutes a gain of from 5 to 10 degrees in cutting angle.

It has extended the working range of the side tool which gives the minimum separating stress.



Chip Breaker for Curling Chips as Used in the Flat Turret Lathe



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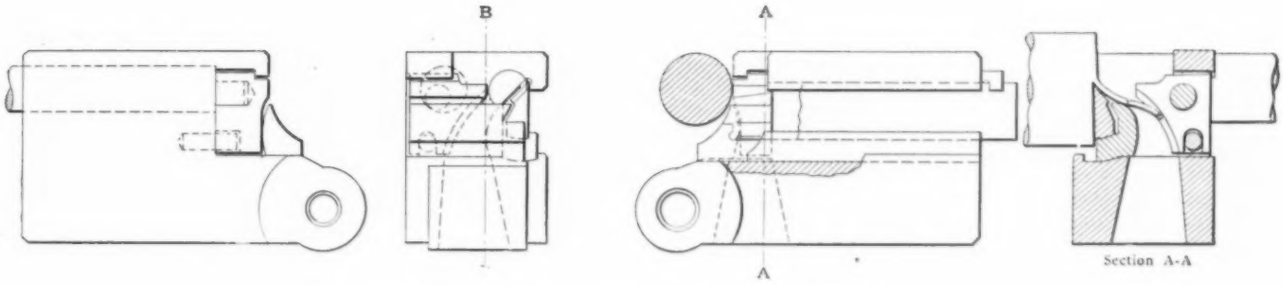


ALTERNATE ARRANGEMENT OF CHIP BREAKER FOR STRAIGHT CHIPS

example; namely, that under ideal conditions the duty of the extreme edge of the tool may be simply to cut through metal which may be under more or less of a tearing or splitting stress.

Although it is, as stated, a satisfaction to be able to stand near the cutting tool, to have some assurance of the direction in which the chip is traveling, and to know that it is integral and not shooting out in hot chunks at all angles from the tool point, there remains the fact that a continuous chip is troublesome.

blunt cutting angles, or at least, tools which produce tolerable chips.

For turning bar work in the turret lathe it has seemed best to adopt a chip breaker which produces a fracture by placing an obstruction in the path of the chip at such an angle that the chip, shortly after it has left the tool, is bent, either by lifting or depressing, or both, to an extent beyond its breaking point.

In order to employ the chip lifter most efficiently for the purpose of relieving the top slope of the cutting tool, the writer

It has made possible the use of acute-angled tools which reduce the cutting stress, thereby increasing the output of machines which have been limited by lack of pulling power.

The reduction of the cutting and separating stresses has increased the accuracy (or output which is generally interconvertible with accuracy) on nearly all lathe work.

This reduction also increases the output which has been limited mostly by the frailness or the slenderness of the work.

The Working of Patented Inventions

By Alfred Muller

As the subject of a retaliatory compulsory working provision in our patent laws is almost certain to be a live one at the forthcoming session of Congress, the readers of the American Machinist should be informed regarding the action of the recent Stockholm Congress of the International Association for the Protection of Industrial Property in connection with the working of patented inventions in the patent-granting countries.

It was agreed at the Stockholm Congress between the representatives of the different countries to approve the resolution of the last Berlin Congress, viz., that the non-working of a patented invention shall *not* bring about the revocation of the patent, the consequence of non-working being merely that the patentee can be compelled to grant a license to others who wish to use his invention.

As it does not appear possible to have this resolution adopted and made law in all the countries adhering to the International Convention at once, the Congress recommended that those convention countries, which are already in position to introduce into their laws a license clause, should form a special convention, which regarding the working of patented inventions prescribes the following:

"In those countries, which adhere to this special convention and whose laws contain articles regarding the working of patented inventions and the granting of a license under such patents, the patent shall not be revoked, or invalidated, for the reason that the invention patented thereby was not carried into effect or a license under said patent was refused. The patentee, in lieu thereof, shall be compelled to give to others the permission to use the patented invention, for a reasonable consideration and a sufficient guarantee, if it appears advisable in the public interest to grant such a license, and after three years have passed since the grant of the patent. The laws of the countries which in this respect go farther still, in order to facilitate the carrying out of patented inventions, shall not be interfered with by this resolution."

Moreover, the Congress urgently recommended, independently of this resolution, that the various countries should make special agreements between each other, such as the one between Germany and Italy, according to which the requirement of the working of the patented invention shall be waived.

The foregoing only proves that all those, who advised the Congressional Committee on Patents in the beginning of this year, not to introduce into the American patent law any working clause, were right While it is true that, at present, the requirement of working in most of the European countries is felt as a great hardship, especially by inventors of this country, where no such requirement for working is made, there is no doubt whatever that the present requirements of working of patented inventions will soon be a thing of the past. I am certain that the Government of this country, which today occupies such a predominant position in the world, can, by reason of just this position, compel all the European countries, whose patent laws still contain the requirements of working of patented inventions, to waive such requirements with regard to citizens of this country, the same as Switzerland did last year.

Pure platinum is nearly as soft as copper, and to harden it for commercial purposes from 5 to 15 per cent. of iridium is used. Pure platinum is rarely used in the arts, as the alloyed metal has been found better for most purposes to which it can be put.—*Brass World.*

Some European High Power Hydraulic Presses

By Frank C. Perkins

In both England and Germany the hydraulic press has always found greater favor than the steam hammer for forging, flanging and similar work, as it is claimed to give a better and more homogeneous product. The high-power hydraulic press is designed and constructed in two general forms; the one with a central opening for admitting the work as shown in the accompanying half-tone, Fig. 1, and the other with a side opening as indicated by the half-tone Fig. 2.

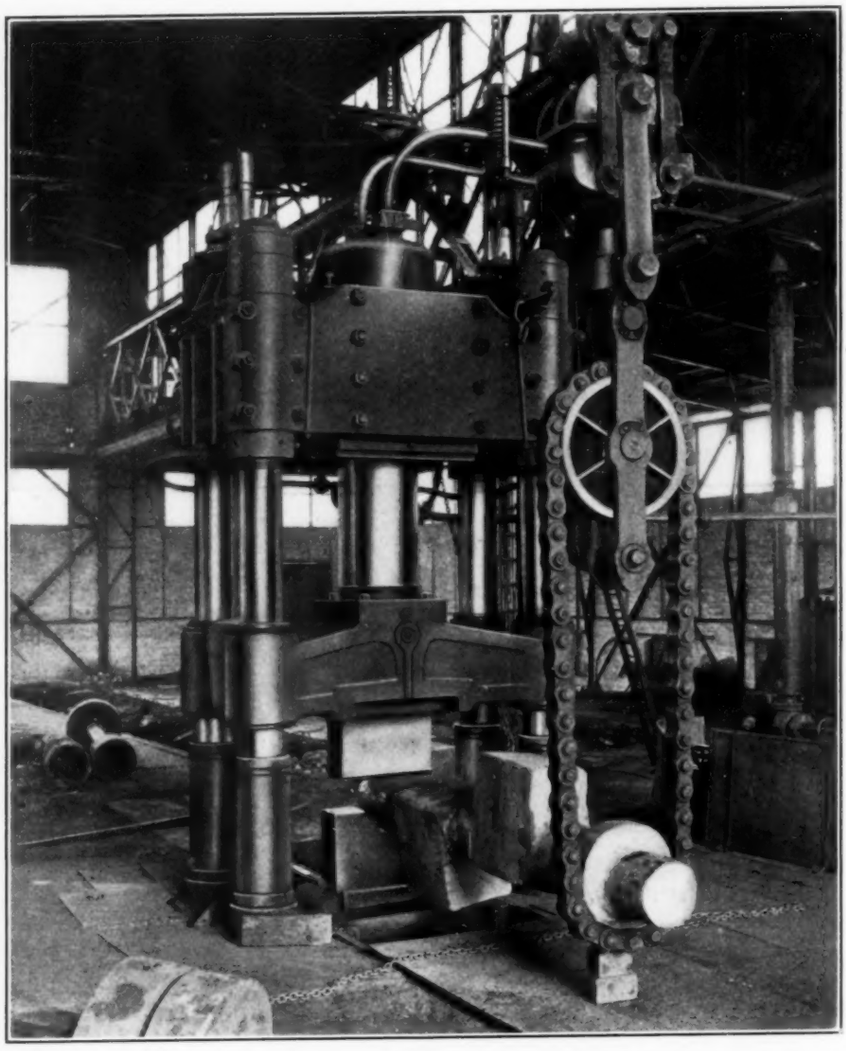


FIG. 1. HYDRAULIC PRESS AT THE OBERHAUSEN PLANT OF THE GUTEHOFFNUNGSHUTTE

Fig. 1 shows a press of German design. It is one of the largest in operation at the Oberhausen plant of the Gutehoffnungshutte. It is the common type, having four vertical rods to support the head, and a single central ram. It is shown at work upon a large crank shaft; the work-holding details are shown plainly.

In the flanging and shaping of large plates, such as are used for the ends of

marine boilers, it is impracticable to heat and operate upon them entirely at one heat. Thus, a press of the type shown in Fig. 2 is used. This press was built at Leeds, England, by Rice & Company, Ltd. It is intended for work upon some of the largest of marine boilers, and will handle

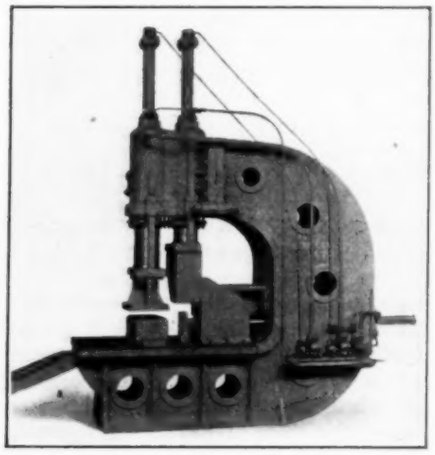


FIG. 2. SIDE OPENING HYDRAULIC PRESS

plates of any diameter, and up to a maximum thickness of 1½ inches. There are two vertical rams and one horizontal ram. The method of operation is as follows: The plate to be flanged is fixed on a central stud bolted in a proper position on the hinged extension of the table. A short length of the circumference of the plate is heated in a furnace arranged at the side of the machine. This heated section is then brought into position on the anvil block. The vise ram descends and clamps the plate firmly in position, while the flanging ram and die turn down the edge of the plate. The flanging ram then rises clear of the work, and the horizontal ram squares up the flange against the anvil block. A fresh length of plate is then heated and the operation repeated until the whole plate has been properly flanged. The anvil block is, of course, shaped to curves of the correct radius required, and as the plate revolves on the fixed stud, a circular flange results that is sufficiently accurate for all practical purposes.

In Fig. 3 can be seen an illustration of a large English hydraulic flanging press having a capacity of 200 tons. It was constructed at Rodley, near Leeds, by the Leed Engineering and Hydraulic Company, Ltd. It will be noted that one-half of the bed plate, the frame, pillar and horizontal cylinder are all cast in one piece. The outer half of the bed, however, and the vertical cylinders are in separate castings. This construction was necessitated by the limitation of railway transportation, for had the cylinder, pillar and bed been cast in a single casting, it would have been too large for transportation by rail. The cylinders are lined with hard bronze. The location of the operating levers and the hydraulic piping can be seen plainly.

Fig. 4 illustrates another type of press designed for the use of steel car builders. This machine is constructed entirely of steel throughout with the exception of the valves which are of phosphor bronze,

FIG. 4. HYDRAULIC PRESS OF A TYPE USED BY CAR BUILDERS

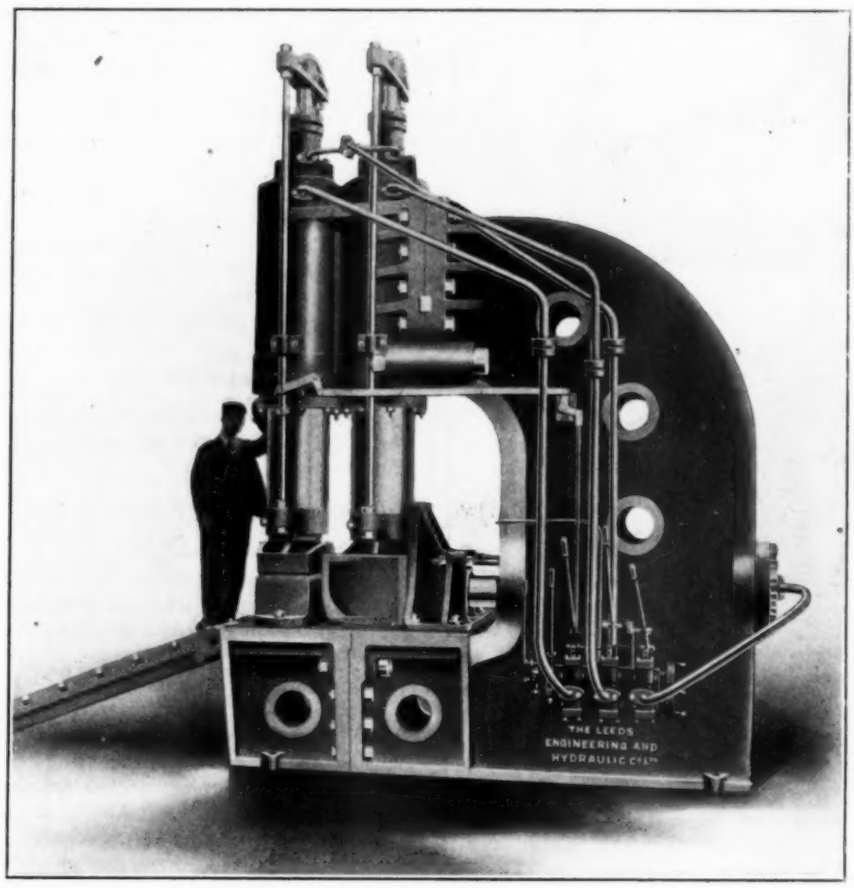


FIG. 3. AN ENGLISH HYDRAULIC FLANGING PRESS

and is capable of exerting a maximum total pressure of 2000 tons. At the corners of this table are provided rams, four in all, for lifting the moving table. As a rule only two of these are required, but the other two can be used at any time, provided the dies stick. The main table-operating rams are three in number and arranged so that one, two or three can be used if desired. This, of course, makes a three-powered machine, and allows of a considerable saving of water at a high pressure.

Another interesting example of an English flanging press intended chiefly for locomotive boilers, is shown by Fig. 5. This press has a table 12 feet by 10 feet in dimensions and is capable of handling all of the various plates used on the largest locomotives at present manufactured. It has eight rams; three main rams, four outer vise rams and one central vise ram. The three main rams are arranged so that the center or the outer or all of the rams can be used as desired. This, of course, makes a convenient three-powered arrangement.

A single lever controls the operation of all of them. The outer vise rams are used chiefly for holding the plates against the top, while being flanged. They are also used for punching out the fire holes in the inner and outer firebox plates. A noteworthy feature in the design of this press is that the rods are made with buttress threads and without any enlarged

portions, and have split nuts underneath the table. The advantage of adopting this design is that in the event of any of the rods being strained or injured, they can be drawn up through the holes without the necessity of pulling down the press. This element of design is of considerable importance from the fact that the smallest table weighs over 20 tons.

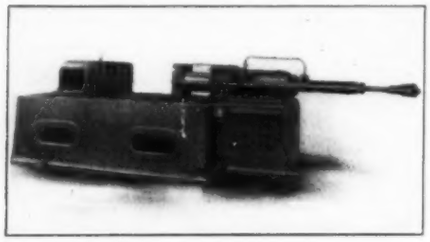


FIG. 6. HYDRAULIC PRESS FOR STRUCTURAL WORK

The horizontal press shown in Fig. 6 is fairly representative of the class of presses used in structural shops. It has a large plain table arranged for the convenient setting, flattening and adjusting of work. The large movable abutment casting has slots for attaching dies and formers of various kinds. If necessary, this abutment can be removed entirely and a large pin dropped into a hole in the bed plate. Around this pin angles, beams, etc., can be bent to suit requirements. The operating valve is arranged with an automatic knock-off so that the whole or any part of the stroke can be used. The bed plate is provided with slotted holes that are convenient for holding and adjusting some classes of work.

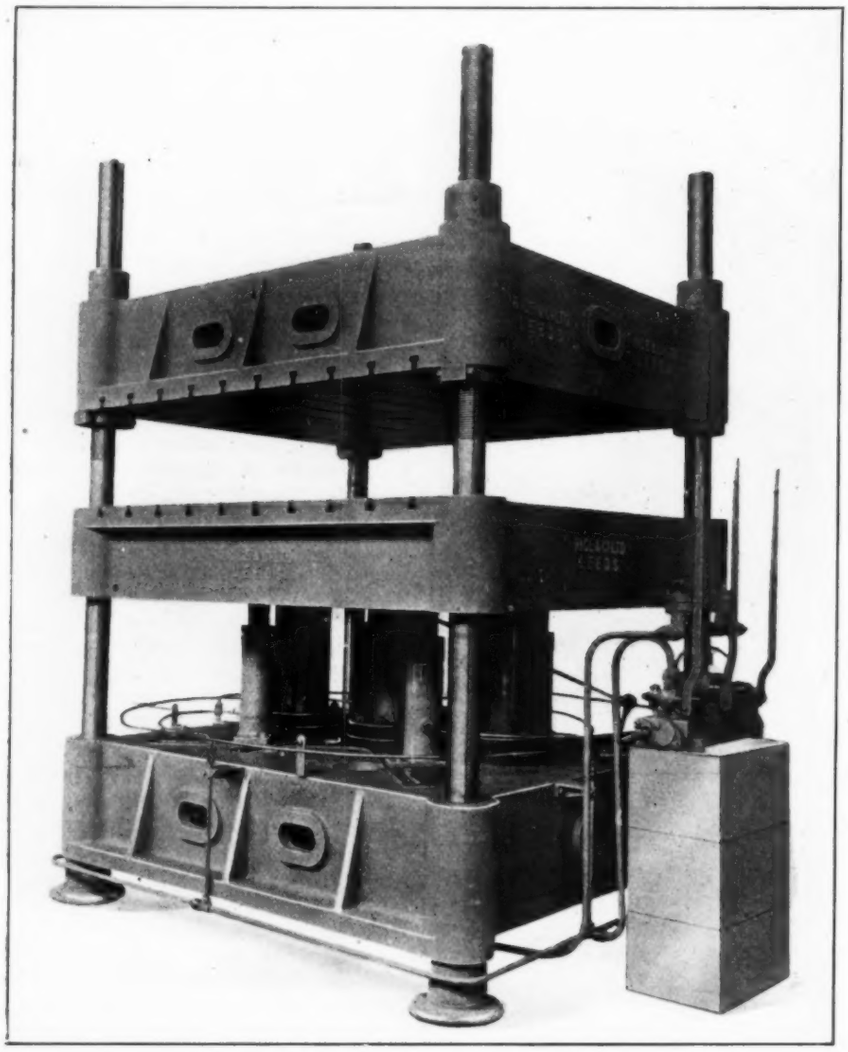


FIG. 5. HYDRAULIC PRESS DESIGNED FOR USE IN MAKING LOCOMOTIVE BOILERS

Generating Gear Teeth of Increased Strength with Standard Hobs

By H. T. Millar

The relatively rapid extension of the practice of gear generation by hobbing in Europe, and the signs that this practice is gaining ground in America give interest to any special feature concerning it. It may be opportune, therefore, to illustrate a feature peculiar to this method of gear production: Gears, particularly pinions, may be produced by the standard hob of the set with tooth strength in excess of those with the standard 14½ degrees pressure angle.

As is well known, the tooth outline of a hobbed worm-wheel of few teeth is not the same as that of a tooth of a pinion of the same number of teeth cut with the ordinary formed cutter. The tooth of the hobbed wheel is undercut to an extent, which makes the width of the space below the pitch line greater than at the pitch line. This shape is, of course, impossible to produce with the ordinary formed cutter which is formed to give radial flanks to the teeth. The addenda of mating teeth in large wheels are adapted to suit. To avoid this undercutting of the flanks it has long been the practice with hobbed worm wheels to increase the outside diameter of the blank for all gears of less than 30 teeth.

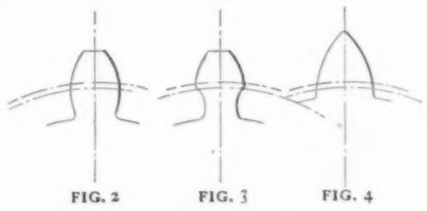


FIG. 2 FIG. 3 FIG. 4

MODIFICATIONS OF THE TEETH OF A 12-TOOTH, 2 D.P. PINION

It has been suggested in an address on gearing by Mr. Humpage before the Institution of Mechanical Engineers that this practice should be extended to hobbed pinions, which work with gears of the standard 14½ degrees pressure angle. I proposed to extend the matter somewhat and to illustrate the advantages in strength and to show the nature of the contact between modified pinions and standard teeth. While Mr. Humpage only suggested the modification in the smallest pinions, and did not mention the use of a formula such as is given below, I think that the use of a rule giving more gradual variation has advantages.

Suggested Formula

A standard formula, in use for worm wheels for obtaining the increased outside diameters is:

$$\textit{Outside diameter} = \textit{pitch diameter}\ 0.937 + \frac{4\,(\textit{circular pitch})}{\pi},$$

which, as diametral pitches are mainly in use for spur gears, may be expressed thus:

$$\textit{Outside diameter} = \textit{pitch diameter}\ 0.937 + \frac{4}{\textit{diametral pitch}}.$$

This formula has the advantage of increasing the diameter and consequently the strength of all gears of less than 30 teeth, yet it preserves the full hight of the tooth for pinions of 12 teeth as will be seen later. As those familiar with the principles of gearing will be aware this increase in external diameter of the blank

does not effect any alteration in the diameter of the base circle for the involute. The effect is a modification in the pressure angle. Fig. 1 gives the outside diameter of gears of 1 diametral pitch from the formula. The diameter also given under the heading of "Nominal Pitch Diameters" will be convenient in fixing the increased center distance necessary between two gears. Of course, for gears of any other pitch the diameters given will be divided by the pitch used.

The necessity for this modification in tooth shape is apparent from Fig. 3 which shows the extent of the undercutting effect on a hobbed pinion of 12 teeth. Fig. 2 shows the tooth shape when cut with an ordinary formed cutter; Fig. 4 the tooth of a hobbed pinion of modified diameter. The advantage in strength is apparent. It will be noticed that the addendum of the tooth, Fig. 4, is incapable of much extension as any further increase in diameter would be removed by the sides of the teeth in the hob. As mentioned previously in the case of the smallest pinions the formula just reaches the limit of modification.

Conditions of Contact

The conditions of contact may perhaps be best obtained from a study of Fig. 5, which shows modified pinions of 12 teeth and 18 teeth mutually in gear and meshing with racks. The racks, of course, are

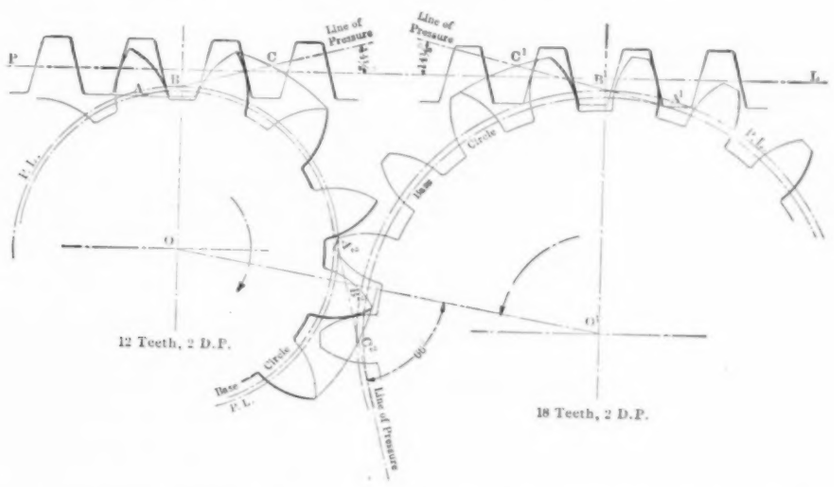


FIG. 5. MODIFIED TEETH OF A PINION IN MESH WITH A STANDARD GEAR AND RACK

of the standard 14½ degrees pressure angle. It will be seen that conditions of contact differ materially in some respects from those of gears cut with the ordinary formed cutters. In the modified gears the width of the space differs from that of tooth, the arc of contact differs in length during approach and recess and, in the case of the mating of the two gears, the angle of pressure is increased.

The reason for the width of the space being in excess of that of tooth is fairly obvious. The larger circumference accompanying the increase in diameter results in an increased pitch measured on what we have called the nominal pitch circle; that is, the imaginary circle which touches the pitch lines of the meshing gears or racks. Since the width of the tool must suit the width of the space in the standard rack or hob the increase in pitch necessarily involves an increase in width of the tooth space. This, of course, involves backlash when two modified gears are in mesh, but not when a modified pinion meshes with an ordinary gear or rack. In the case illustrated in Fig. 5 the backlash is excessive, but the case is rather an extreme one since the amount of backlash roughly increases inversely as the number of teeth in each pinion.

The difference in the length of contact during the approach and recess is one of the chief features of these modified gears; the contact is equal, of course, in the case of ordinary gears. In Fig. 5 the length of contact during approach in each case is signified by AB, A_1B_1, A_2B_2, and that during recess by BC, B_1C_1, B_2C_2, respectively. It will be seen that when the smaller drives the larger gear, as is usually the case, the contact during recess exceeds that during approach. This is an advantage, though its importance is a matter of some difference of opinion. It is well known that, due to the modifying effect of the friction between the teeth when sliding over each other, the direction of the resultant force on the driven tooth is such as to exert a greater moment during recess than approach. The advantage is often held to be slight. On page 262 Mr. Mills quotes the practice of the *Algemeine Electricitäts Gesellschaft*, which uses a gear system with unequal addenda. According to their experience covering several years the amount of wear on the teeth is considerably less when the greater part of the contact occurs during recess. It may be noted in passing that when the teeth of worm wheels are modified the greater part of the contact occurs during approach.

Changes in Angle of Pressure

Perhaps the most notable feature of this modified system is the angle of pressure. With most systems of involute gears the pressure angle forms the base of the system and is constant throughout the system. Here, though the base is a 14½-degree rack the pressure angle is variable. It is dependent upon the number of teeth in the mating gears. Thus

Number of Teeth in Gear.	Nominal Pitch Diameters, Inches.	Outside Diameters, Inches.
12	13.244	15.244
13	14.181	16.181
14	15.118	17.118
15	16.055	18.055
16	16.992	18.992
17	17.929	19.929
18	18.866	20.866
19	19.803	21.803
20	20.740	22.740
21	21.677	23.677
22	22.614	24.614
23	23.551	25.551
24	24.488	26.488
25	25.425	27.425
26	26.362	28.362
27	27.299	29.299
28	28.236	30.236
29	29.173	31.173
30	30.110	32.110

FIG. 6. TABLE OF MODIFIED GEAR DIAMETERS FOR ONE DIAMETRAL PITCH.

the pressure angle between a 12-toothed pinion and a 48-toothed gear is less than that between pinions of 12 and 18 teeth. All modified gears, however, when meshing with a rack exert pressure along an angle of 14½ degrees.

In conclusion, the objection may be anticipated that while some modification is desirable in the case of hobbed pinions, the formula here used has too wide a range and creates too great an increase in diameter in the smaller pinions. This, of course, is a matter for discussion. It must be admitted that a formula which involved less modification would necessarily involved less backlash when two modified gears are in mesh. But this formula has the advantage of being already in use in connection with worm wheels. It gives the strongest possible shape to the pinions; and the disadvantage in backlash is liable to be exaggerated since two modified pinions will not usually be in mesh.

An interesting discovery, according to *Engineering*, is stated to have been made by a wharf builder, of San Francisco, who was rebuilding an old wharf in which the pile had been badly destroyed by borers—*Teredo navalis*. One pile was found to be thoroughly sound, and a careful investigation of the cause of this exception revealed the fact that the piles had been used to support a live wire. He then carried out experiments with electricity upon wooden piles, and discovered that the teredo would not bore into a pile in which a very small current was maintained.

Wire Gages—Planer Speeds

By John R. Godfrey

Wire gages have always been a much discussed subject, especially by those who use them only occasionally, and can't for the life of them tell whether a No. 16 or No. 19 is the size they want. It's an easy matter to memorize a few sizes that you happen to be using, but the rest of the gage means about as much as a Chinese laundry ticket does to a Scotchman.

Now I haven't any special gage to propose, because if we are going to forever use numbers that don't mean anything, the gages we have are as good as any I can think of. The only improvement that seems possible in this line is to combine on one, any one that you might name, and discard all the rest.

But the only plan that appeals to me, and it isn't new, because I saw it advocated in the American Machinist at least 20 years ago, is the one where a number means something. I never could see why an arbitrary number should be adopted for anything, even a milling machine or a grinder.

Why not let 0.001 inch be the base, and then a No. 17 wire or sheet would be 0.017 inch? Everyone would know, and there wouldn't be any hunting up tables or gages. A micrometer would be all you needed for any measurement. The makers of celluloid do this, and it's the most sensible method I know of.

And manufacturers can aid in bringing about such a change by simply ordering material by thousandths of an inch instead of numbers. Say nothing about the gage numbers as we now have them, but just order as many miles as you want of wire 0.020 inch in diameter, or sheet metal 0.038 thick. If you want a number just call the first No. 29 and the other No. 38, and you have a system that needs no interpreter.

Slower Planing Speeds

There are many difficulties in the way of laying down iron-clad rules for cutting speeds, or almost anything else, and a new phase of the question came to light the other day in a large tool-building shop. Realizing the power of imagination in affecting the output of machines or the distress of cutting tools, they had speeded the line shaft up a little, perhaps 10 per cent., without saying that it had been changed in any way.

Some of the men seemed to get along about as before, some earned a little more money than before, but their best planer hand on the big work complained bitterly that for some unknown reason he was unable to turn out as much work as before owing to the tools not standing up to their work. This was allowed to go on for a time to see whether it was all imagination or not, and then the planer was put back to the old speed, still without saying anything to the man who ran it. He immediately began to turn out more work, and was correspondingly happy, for there is nothing like piecework, or some of its variations, to show up the capacity of a machine as well as its operator.

The best speed in this case was about 28 feet a minute on cast iron, and the shop manager is willing to back this man and the speed named against any other similar combination on earth, so confident is he that the results are better than can be obtained with a higher cutting speed when actual output is considered. This would not be so impressive if the operator was working by the day, but the pinching of the pocketbook tells the story better than any set of time charts or cost systems.

This does not by any means prove that this speed is best for all planing, even of cast iron, but it may indicate that high cutting speed is not the only consideration and that in some instances we may be running too fast to secure the best results unless the steel used for tools differs radically from the average. The steel used in this case was the kind that had proved best for the work, but it is an open question as to how far this entered into the results obtained.

Sir Oliver Lodge has, for the last three years, according to the *Iron Trades Advertiser* engaged in experiments in the electrification of crops, and, recently speaking he said they had found that wheat crops yielded 30 to 40 per cent. more grain than they otherwise would on the same land and in the same season. Strawberry beds and fruit trees also yielded a greatly increased crop, but three years was not a long enough time to allow him to make any dogmatic utterances upon the subject.

The "Eichhorn" Trigonometric Slide Rule

A new slide rule, known as the trigonometric slide rule, is about to be put on the market by M. J. Eichhorn, 5759 Aberdeen street, Chicago, Ill. It is intended for the solution of triangles and is especially arranged to solve the general trigonometric equation for the third side of a triangle, having given the other two sides and the included angle, which is

$$C^2 = A^2 + B^2 - 2\,A\,B\,cos.\,c. \qquad (1)$$

Referring to the illustrations, Fig. 1 is a half-tone from a photograph of the rule. Figs. 2, 3, 4 and 5 show settings to solve certain problems that will be described. Referring to the equation given above, if we make

$$2\,A\,B\,cos.\,c = X^2 \qquad (2),$$

equation (1) will read

$$C^2 = A^2 + B^2 - X^2 \qquad (3)$$

This is in a quadratic form and is solved directly by the upper scale on the rule and the upper scale on the slide; both of these scales are graduated to the function of the square. The scale on the slide has its zero at the center and is graduated alike in both directions. To solve a typical example let us assume that $A = 6$, $B = 8$ and $X = 4$; to find the value of C, from the relationship expressed in equation (3). The setting of Fig. 2 shows 6 on the upper scale of the rule, opposite 8 on the upper scale of the slide, and opposite 4 on the slide we read 9.15 approximately as the value of C. It will be noticed that X is read in the same direction as B for the reason that X^2 has a minus sign in equation (3).

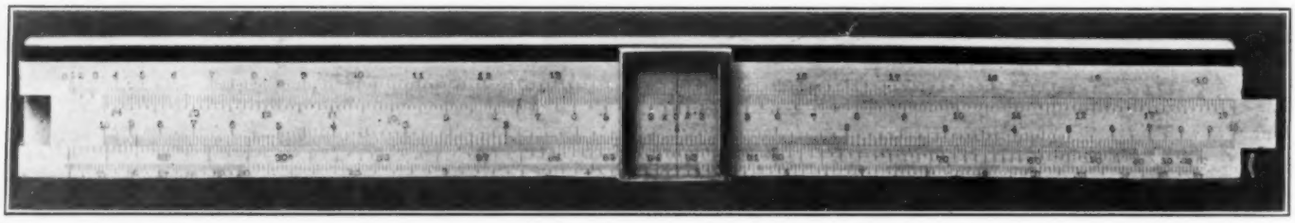


FIG. 1. THE "EICHORN" TRIGONOMETRIC SLIDE RULE

In case the angle c of equation (1) equals 90 degrees, X^2 equals zero, and equation (3) becomes

$$C^2 = A^2 + B^2 \qquad (4),$$

or the equation expresses the relationship between the three sides of a right-angled triangle. This is, of course, readily solved by the upper scale of the rule and the upper scale of the slide. Let us assume in Fig. 2 that $A = 6$, $B = 8$, to find C as expressed by the relationship of equation (4). The setting shows 6 on the rule opposite 8 on the scale, and opposite zero on the rule we read 10 on the scale for the required value of C.

However, the value of the trigonometric

slide rules lies in the solution of triangles other than right-angled triangles. This is accomplished by a determination of the value of X from the lower scale on the slide, and the two lower scales on the rule. After X has been determined it is used as indicated in the first illustrative example. Equation (2) can be transformed logarithmically to read as follows:

$$2 \log. X = \log. A + \log. B + \log. 2 \cos. c.$$

The lower scale of the slide is graduated in both directions from unity at the center and expresses the relationship $\log. A + \log. B$. The upper of the two lower scales of the rule is graduated to $\log. 2, \cos. c$ 2, the numbers representing degrees are arranged from 0 to 89 +. The lowest scale of the rule is graduated to give $2 \log. X$ and is in reality an ordinary logarithmic scale of double the size of those used for $\log. A + \log. B$ and $\log. 2 \cos. c$. In using these lower scales there are two things which should be remembered; first, that X is negative when the angle c is greater than 90 degrees, and that in such cases the complementary angle must be used for c.

For an illustration of the settings of the rule to solve the general trigonometric equation for the third side of any triangle see Figs. 3, 4 and 5. In these the two known sides of the triangle are assumed to be 6 and 7 and the included angle 55 degrees. In Fig. 3, 6 on the lower scale of the slide is set opposite to the angle 55 on the upper of the lower scales of the rule. As 7 on the lower scale of the slide at the right, which represents the other known side of the triangle, is not opposite the lower scale of the rule, the slide must be shifted to the position shown in Fig. 4 before the value of X can be read. From an inspection of Fig. 4 this value is known to be 6.94. Fig. 5 shows the proper setting to determine the value of C after the value of X has been found. Here, 6 on the upper scale of the rule is set opposite to 6.94 on the slide and the value of C is read from the upper scale on the rule opposite 7 on the upper scale of the slide. This value gives C as 6.07.

To put this method for finding the third side of a triangle when the other two sides and the included angle are given, in the form of a rule: On the lower part of the slide rule opposite c on the rule set A on the slide; opposite B on the slide find X on the rule. Then, on the upper part of the slide rule, opposite X on the rule set A on the slide; opposite B on the slide find C on the rule. The value of C is the result desired. When all three sides of a triangle are given and it is desired to find the angle included between two of them, the solution is found directly from the front of the scale and the method expressed in words is as follows: On the upper part of the slide rule opposite C on the rule set A on the slide, opposite B on the slide find X on the rule; then on the lower part of the slide rule opposite X on the rule set A on the slide, opposite B on the slide find the

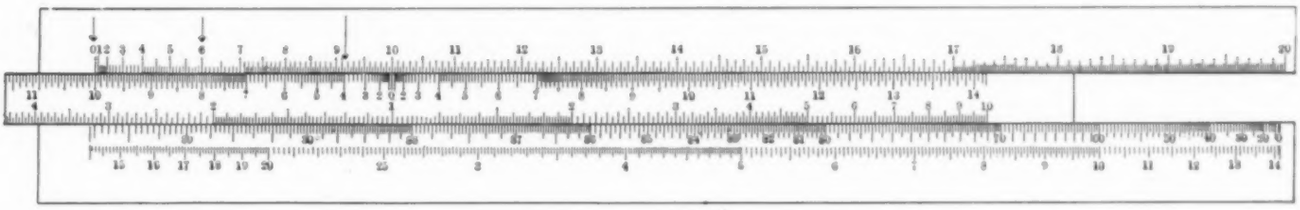


FIG. 2

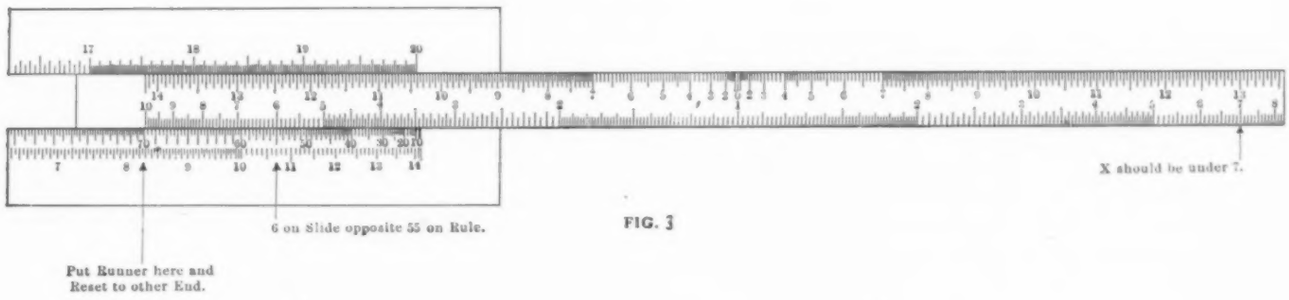


FIG. 3

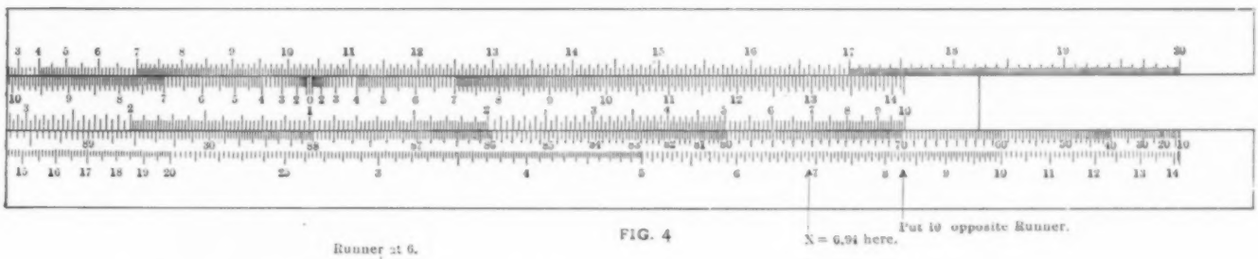


FIG. 4

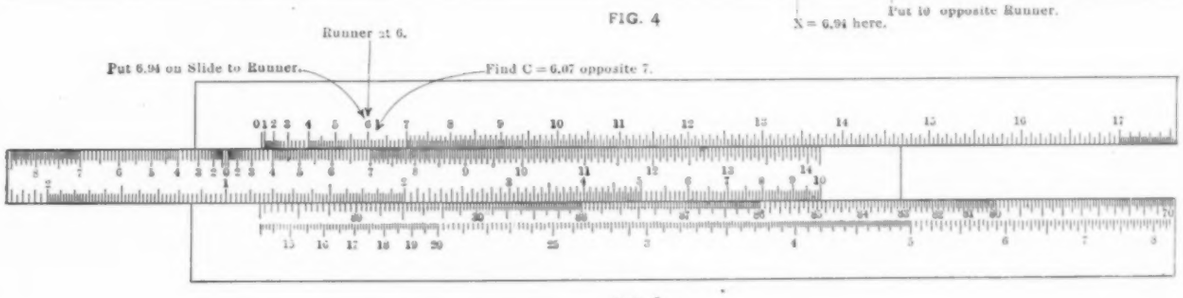


FIG. 5

ILLUSTRATIVE SETTINGS OF THE TRIGONOMETRIC SLIDE RULE

angle *c* desired. This process can be repeated for each of the angles and thus all three can be found readily.

On the back of the slide is a double-line sine scale that is used when all three angles and one side of a triangle are given. This same scale is also used when the two sides of a triangle and the opposing angle are given. The back of the slide is also provided with the usual scale of logarithmic tangents from 6 to 45 degrees, inclusive.

Patent Experiences—Selling a Patent and Paying the Purchase Price Oneself

By Wit Bec

Walking into Joe's shop one afternoon, he said, "I notice from the papers that you've sold one of your patents, Wit, for 10,000 shares of stock, highly spoken of by the paper. Congratulations."

"Joe, that's all bosh. I did get the stock, but it's worthless. I'll tell you about it."

"A friend of mine," I said, "went out hunting, wearing his 45 Colt's on his holster as usual, but with all six chambers loaded, when in stooping to light the camp fire, the end of the barrel struck his leg, tipping the gun and holster so that the gun fell out, striking the hammer on a rock, and he died from the effects of the shot in the abdomen a few days later. Well, I was using the same kind of an arm and I got to thinking. I was working as a bank clerk in Salt Lake City at the time, and the idea kept coming and coming; and coaxing and coaxing, until I couldn't help making one for my own use. I had no idea of patenting it, as I simply wanted to fit the gun I was using with some device that would prevent any such accident to me. So I put a safety lever on the under side of the handle, which, unless gripped by the hand of the shooter, the inside end, a solid bar of steel caught the descent of the hammer and prevented it from touching the primer. There could be no manner of firing the arm except "on purpose." I liked the idea and used the gun for months. One day a former army captain saw it and being pleased with the idea advised getting a patent right on it. Well, I guess the advice of friends is the most hurtful thing a young man can get; and it isn't confined to patents either.

Getting the Patent

"Away I sailed to interest somebody to the extent of putting up 'the necessary;' one was found willing to put up $65 on it, and off I went to a patent solicitor with all canvas of egotism spread to the breeze that was soon to blow me out into the ocean of successful inventors.

"Well Joe, you should have seen me about then. I felt very important. How I assumed the studious and how seriously I took all things, most so myself! A patentee! The inventing bee got into my bonnet and the sting swelled my head. No article came along that I didn't dig open with a view to improve it. A second Edison was now on the horizon. Budding genius was sending forth its first sprouts.

Tempting Offers to Exploit

"The patent came duly to hand, followed by floods of letters, postals and circulars. *Everyone* in the East was a patent seller, had been struck with the utility of my device, and as they were careful and conservative, they had passed up thousands of worthless inventions that year as not worthy their time, but were interested in this device of mine and wished to handle it because of its merit. Some said to send along a small registering fee to place my name on their list to be mailed to eager manufacturers, who had an aggravated itch to get hold of just such moneymakers, and with whom they only were in touch; others were getting a pamphlet ready for the press, proof sheets of which they were inclosing, and a cut of my patent with suitable real live reading matter explaining it could appear in the blank space marked X for only $5 and reach alert and progressive manufacturers; others sent testimonial letters from a patentee who wrote on a printed letter head of his company of which he was now president, thanking them for their executive skill in promoting the company, which none but they could have carried to a successful issue. In fact to sum it all up, *my* patent was THE one of the year. For weeks Uncle Sam was on the run with alluring, tempting, inducing letters, each one skilfully hiding under the guise of registering fee, cost of cut, evidence of good faith, or other name for it, the need of sending them $5. Those letters are of all kinds and so nicely made up that a fellow finds it hard work to restrain from trying some of them. I lost no money on them. One day a postal came from a firm saying that they had an offer for my patent; would I sell? If so, reply on the second half of the postal, stating price, etc.

"Well, I took their word for it that they did have an offer. And having an offer to buy, when the price was made by me, they could get in between and make the difference, if they really did have an offer; but if they were merely working me, I would soon find out. To find out I would put the price right down to where there would be no excuse for not taking me up on it. So I wrote back that if they meant business, yes, the patent was for sale for $75, spot cash to them, and they could have all above that they could get. But if they merely wished to try me on some scheme to touch me for a few simobones they might as well not reply. What a roasting they did give me in their injured innocence! If I wasn't sufficiently interested in my own invention to evidence my faith in it by paying the small advance commission they would ask, how could they be expected to supply that faith, and do an all one-sided business for me?

"Real-estate dealers and other commission men charge their commission or fees after they make the sale, but not so the patent seller; he must have his fee in advance, and Joe, out of all the many thousands of patents got out each year, if they get a few hooked for a fee what does it matter if they don't make one real bona fide sale out of hundreds—there's a good thing in fees alone.

"Well, I shook hands with myself that I had steered clear of patent sharpers, only to get caught later."

"How was that, Wit? Are there other methods?" asked Joe.

The Offer That I Bit At

"Yes, pretty good looking ones too. Enough so that I bit, and made the sale you mentioned having read in the papers. Over a year passed and I got a letter from the ——— Manufacturing Company, of ———, offering me 10,000 shares of their capital stock for my patent rights. I was as cautious as a kitten with a puddle of water. I would take $250 cash instead. A pretty big drop-down from stock of the par value of $10,000 to $250 cash. No, their by-laws prohibited them from buying any patents in cash; they were chartered under the laws of Arizona, capitalized for the modest sum of $65,000,000, of which they would give me 10,000 shares of CLASS A, PREFERRED stock for my patent right, fully paid up, non-assessable—absolutely no compulsory manner in which this stock could be made an expense to me.

"Suffering Jehosaphat! Sixty-five millions! I got to wondering what my 10,000 shares might be worth (particularly when $250 in cash instead of the stock wasn't given me), so I wrote on. The reply was: 'Our stock has changed hands at all kinds of prices; we can, therefore, not quote you a price on it as it is not in the open market.' I forgot to tell you Joe, that besides the stock they offered a 10-per cent. royalty on all sales under my patent right. I was still troubled about the value of the stock, and asked for a copy of the company's prospectus. It came. Four thousand dollars was the extent of the assets claimed for the company, and it is to be assumed that even that wasn't undervalued. If all the stock were to be issued I would participate one sixty-five hundredth of $4000 for my pro rata share, or about 60 cents.

"But CLASS A, PREFERRED! The last word got me. I must have some PREFERRED stock at any hazard of value. So I closed the deal, sent them in $3 to cover the cost of recording the

deed of sale of the patent, and got back the cutest, gold-printed certificate calling for 10,000 shares of Class A stock and PREFERRED in great, bold gold letters across the face of the whole certificate. And non-assessable too, Joe! No Irish dividends there! Another dollar brought me the by-laws wherein I learned that Class C stock got a 12 per cent. dividend, next Class B 10 per cent., and Class A came in for 5 per cent. of the balance. I'll read to you from the by-laws: 'Class 'C' is the stock that we will sell to the general public from which we expect to get the bulk of our funds. Classes 'A' and 'B' have been arranged to separate the goats from the sheep. These classes have been arranged to let the foolish inventor keep a back seat.'

"I could change from a goat to a sheep by paying certain assessments or the difference in the price of the classes of stock in cash. I have been content so far to remain a 'Billy' rather than a 'Baa.'

"And the company published a little monthly magazine devoted exclusively to *its* interests, which, now that I was a stockholder were *mine* also, carrying a FOR SALE column in which stockholders could list their stocks for sale. I planked up another dollar, and felt consoled that others had been bit as well as myself, for here was a list monthly of offerings of Class A stock for sale for a mere song."

I Had Paid the Purchase Price of My Own Patent

"Well, how did the paper come to publish this nice write-up?" asked Joe.

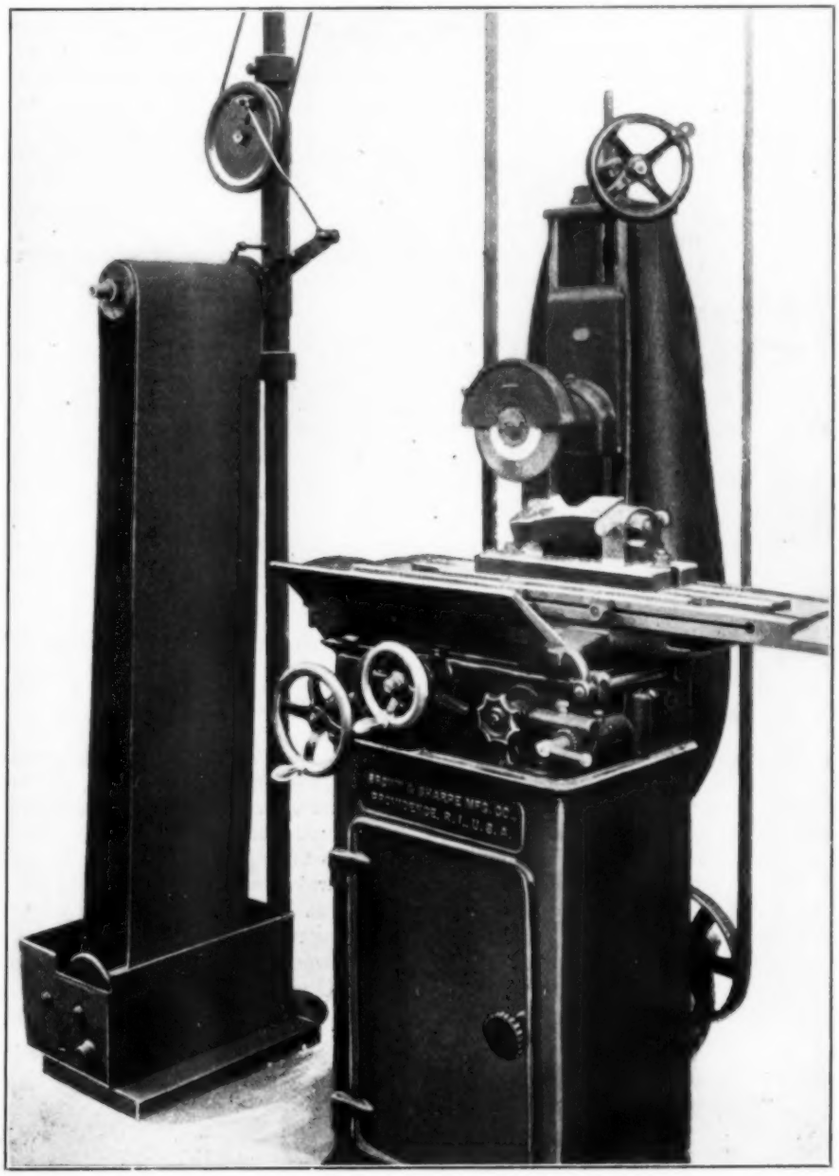
"Why Joe, the humor of the thing struck me after a while, that I had sold my patent for $3 and paid the money myself under the guise of a recording fee. I thought I would play even with somebody. I knew a reporter that I thought I could work, so I gave him a little dope about having sold a patent right for 10,000 shares of stock, mentioned something about a 'scoop,' and said, 'you know how to say it gracefully,' and that gillie shot me out in the next morning's paper as the rising young inventor who had just completed a deal in financial circles, consummated with rare financiering skill and ability, gaining for a valuable patent the product of my inventive genius, 10,000 shares of the capital stock in a large Eastern corporation of extensive interests, devoted exclusively to the manufacturing and selling of meritorious patented specialties, and that the company would soon commence on a large scale to make and sell my ingenius contrivance. The cuss closed by saying, 'When called upon by our reporter, Mr. Bec had made no definite plans for the future, but was modestly receiving the congratulations of admiring friends, and to our interrogation whether he would give up his present position to now enter broader fields, stated that he would continue his present work as a bank clerk while perfecting other ideas on which he was working.' Oh, Slush! And my high rubbers pawned for summer glad rags. Maybe, Joe, a whole lot of the newspaper successes we read about are of just such guff as mine."

A patent fuel has recently been brought out by a French inventor, designated as "charbonnette." This fuel, it is stated, can be produced for about two-thirds the cost of coal. It lights easily and, rapidly becoming incandescent, no smoke is emitted, while at the same time it gives out intense heat and leaves very little ash. It is manufactured in briquets, and its main features are cleanliness in handling and the absence of odor. According to the *Electrical Review* it is understood that the preliminary tests have been so satisfactory that a manufactory is to be erected.

Wet Belt for Catching Emery Dust

By J. W. Carrel

The half-tone illustrates a device in use at the works of Alfred Herbert, Ltd., Coventry, England, for gathering emery and metal dust from work which is of a character that precludes the possibility of making use of exhaust apparatus. It consists of a wet-belt attachment, which is shown in the illustration, as located at the side of the Brown & Sharpe surface grinder, the belt being carried on a roller which is given an intermittent motion by pawl and ratchet operated by the small grooved pulley directly above. The lower roller is located in a water tank in which the fine dust is deposited as the belt passes through the water. A number of these belts are in use at the Herbert works, and have been found very efficient.



WET BELT FOR CATCHING DUST FROM SURFACE GRINDER

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

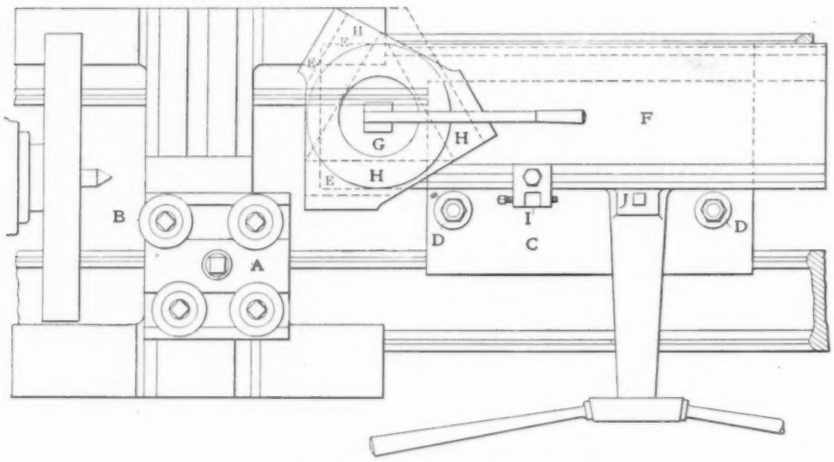
Planing a Large Punch Frame

This job of planing a punch frame which weighs 18 tons, was done in this way because our open-side planer was rushed at the time. It shows a T-piece bolted to the planer platen. The cross of the T-piece is planed to fit a planer head which we removed from the rail. To secure a power feed vertically, we placed a star wheel on the screw and a bar with an arm extending down, so that when one spoke of the star wheel strikes this arm it raises or lowers the head. The bar supporting this arm is held in the other planer head on the rail. I think the photographs which are arranged in first angle projection will show plainly enough how the job was done.

Janesville, Wis. H. F. S.

Lathe Equipped with Turrets for Special Work

The sketch shows roughly a top view of a lathe which was rigged up for a special job. The scheme which we used struck me so favorably at the time that I thought of patenting it. Now the time has long gone past when it would be possible to do so, consequently the idea is free to anyone who may be in the same predicament. The work was something that could be held in a chuck for the most part and was to be operated on by both turning tools on the outside and by boring and drilling tools on the inside at the same time.



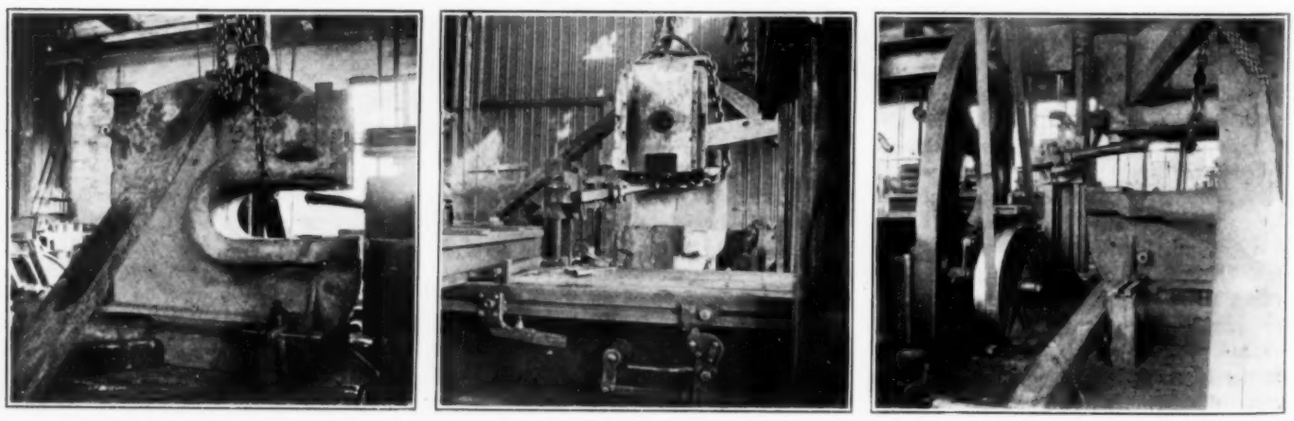
LATHE WITH SPECIAL TURRET

The square turret *A* has nothing novel about it except its size (8 inches square on an 18-inch lathe), and the fact that it is offset to the right on the carriage. Some previous experience with similar turrets showed us that if we wished to use ordinary tool posts we needed all the room that we could get. To get the room and still keep the operating tool *B* squarely supported by the carriage all that we had to do was to shift the center of the turret to the right.

Now to get the boring tools to start on the outside end of the work at the same time that the turning tools did, with the ordinary turret would mean that the boring tools would overhang 8 inches. To avoid this trouble we made an offset turret on the bed. *C* is the turret base clamped by bolts *D* to the bed of the lathe.

The top part of the base follows the dotted lines *E*, *E*, *E*, overhanging the bottom part so that the lathe carriage can pass under the back and left-hand end, and so that it can support the turret slide *F* when it projects beyond *C*. *G* is a triangular turret with holes *H*, *H*, *H*, for ordinary turret tools or boring tools. A four-hole turret could possibly be used, but it would not be so convenient on account of the holes crossing each other at the corners.

The advantage of this arrangement lay largely in the fact that most of the work on the special pieces that we were machining was on the projecting ends. For such work it is possible to get two tools to the work close together and both well supported. If the work had been something that required boring and turning the whole length some of the advantages would have disappeared, but it always seemed to me that for an all-round general utility machine it had a lead over anything on the market. We did not have



PLANING A LARGE PUNCH PRESS FRAME

work enough to keep the machine busy all the time, so we put in the swinging stop at *I* with a set screw to abut against the stop pin *J* and then put a shouldered bushing in one of the turret holes and in the bushing an ordinary lathe center and proceeded to use the lathe for ordinary turning. When doing ordinary turret-lathe work, stop *I* was placed the other side of *J* and used for a depth stop. An unlimited number of additions to this simple tool in the way of automatic feeds and stops and geared heads and feeds would, of course, add to the cost and, therefore, to the salability, but the simple essentials were all that we needed.

E. H. Fish.

Worcester Polytechnic Institute.

Cutting a Distributing Screw

While going through a shop some time ago I noticed a lathe carriage moving to the right and left with great regularity.

I asked the foreman what was being made on that lathe and he told me that it was a distributing screw. I almost asked him what that was, but he did not let me show my ignorance. He took me to the lathe and this is what was being done: A right- and left-hand square thread was being cut on one piece in the same space, using a master screw to move the carriage to and fro.

In the drawing *a* is the master screw, *b* is the piece to be threaded; *c* is a yoke or fork made of tool steel and tempered; *d* is the tool for cutting the threads. It is made with clearance on both sides as indicated. A roughing tool and a finishing tool are used. The roughing tool is 1/32 inch less in thickness than the width of the space when finished; the finishing tool is made the width of the required space.

A cast-iron block *e* is fastened to the carriage with two bolts, one back and one front. This piece has a hole drilled in it to receive a stem on yoke *c*. The hole must be drilled so that it will be in line with the center of the lathe. At *f* is a cast-iron sleeve with square-head set screws, two in each end. This sleeve is used to hold the master screw and piece to be threaded as one yoke *c* is made so that it will swivel at the end of each thread. This is best accomplished by fitting in place to the master screw before tempering.

The screw which I saw cut was 12 inches long, 1¾ inches diameter, ¾ inch lead. The time required was 1¾ hours. The lathe was operated by an apprentice boy.

Philadelphia, Penn. C. H. Erb.

Tool for Turning the Clearance in Gasolene Engine Cylinders

It is customary when designing an automobile cylinder to have at the upper or explosion end a clearance varying from ¼ to ½ inch wide for the boring tool. Owing to the very thin wall of metal in the cylinder care must be taken when making the core box so that it will leave a recess just sufficient to clear the tool. This is not always the case as there is many times just enough irregularity in the core to necessitate the use of a "recessing" tool, and the accompanying line cuts show a good design for one of these tools.

The cylinder for which this tool was designed requires finishing on half of the circumference of the recess only, as the opposite half has the port opening in it,

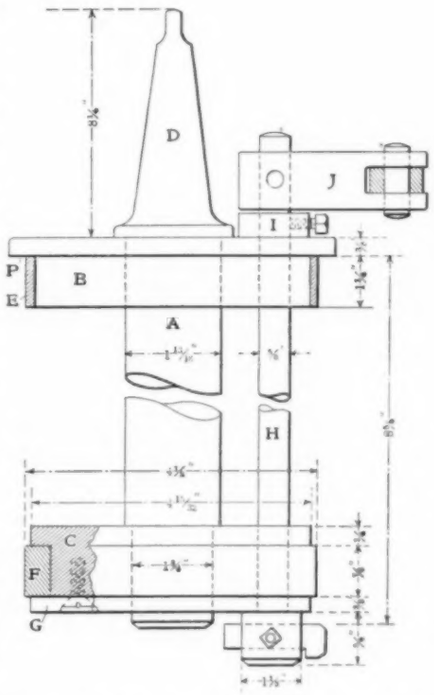


FIG. 1. TOOL FOR TURNING CLEARANCE RECESS

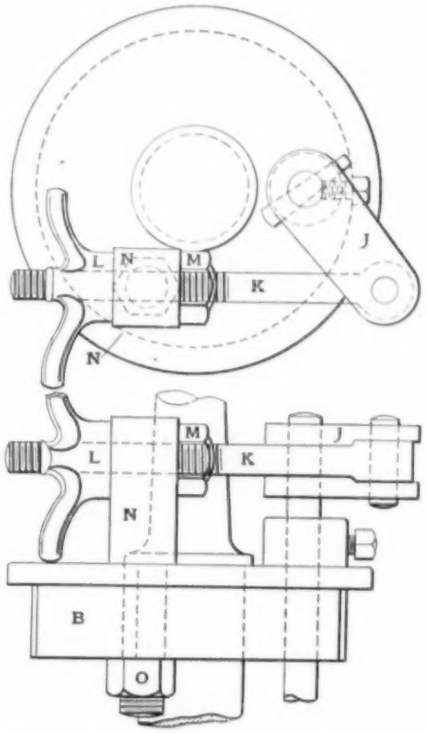
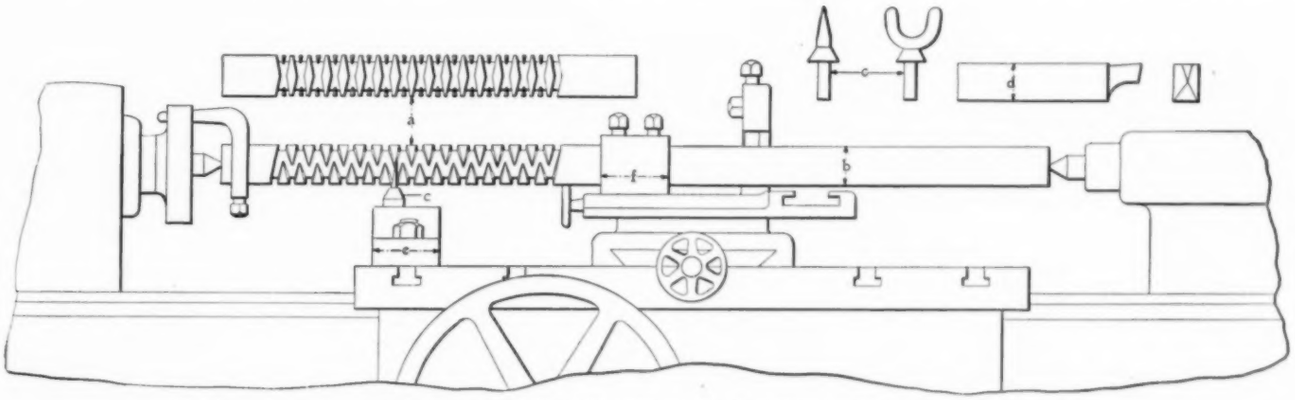


FIG. 2. SIDE AND END VIEW OF SAME TOOL

which cuts through just one-half of the circumference by ⅞ inch wide.

When not assembled, it sometimes happens that the piston is allowed to enter too far into the cylinder so that the top piston ring passes the finished part of the bore and expands into this cored recess, and while in this condition it is apt to catch and cause trouble when drawing the piston back. To prevent any trouble of



CUTTING A RIGHT- AND LEFT-HAND DISTRIBUTING SCREW

this kind at any time the recess is machined and particular attention is given to chamfering the upper edge of the bore, which is all done by the tool shown. The tool is completely inclosed while it is doing the *recessing*.

In the tool, which is shown by Figs. 1 and 2, *A* is machine steel turned to receive heads *B* and *C*; the upper end is turned a Morse taper and fitted to a heavy drill-press spindle. *B* and *C* are cast-iron heads bored to a force fit on arbor *A*. *B* is padded with leather on the face as at *E*, and is intended to prevent any destruction to the bore when revolving therein. Head *C*, instead of leather, has a cast-iron idler ring *F*, which is made to fit snug in the cylinder, and at the same time allow head *C* to turn within it. It is held up by the brass follower *G*. *H* is a machine-steel shaft headed at one end, and through this head is cut a slot in which is fitted the recessing cutter, to be secured by a set screw.

The shaft *H* passes through heads *C* and *B*, and is held and adjusted by collar *I*. *J* is a machine-steel arm that is secured to shaft *H*. It is also slotted and drilled to fit into a pin to receive the end of feed screw *K*. *L* is the feed nut and *M* the lock nut; *N* is a shoulder bolt drilled for screw *K* to pass through. The other end passes through head *B* and is secured by nut *O*.

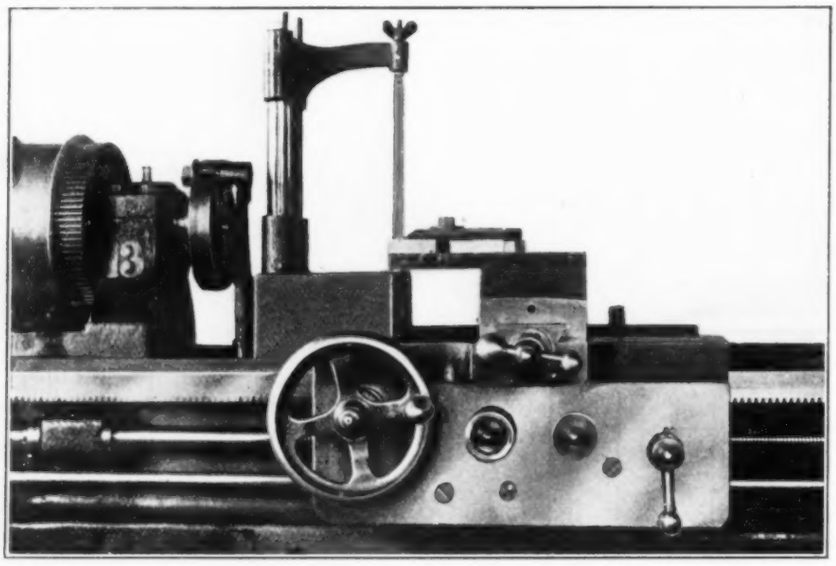
The bore of the cylinder in this case is 4½ inches, and *B* at *E* and *C* at *F* are also 4½ inches, or, in other words, turned to fit in the bore. The tool is secured in the spindle and the cylinder (open end up) in a holder on the table of the drill press. The tool is lowered into the cylinder until the face *P* of head *B* rests on the finished end of the cylinder; then the recess is bored and the depth of this regulated by the thumb screw *L*.

Milwaukee, Wis. GEORGE MURPHY.

A Lathe Hack Saw

A novel type of power hack saw is shown in the accompanying cut. As constructed, it consists of a cast-iron block clamped to the ways of the lathe. This carries four guides, two extending up as shown, and two downward, which are not visible. These carry the saw frame, which is cast in one piece. At the lower end the connecting rod is fastened, the other end of which is connected to the face plate of the lathe.

The advantages claimed for this machine are that the operator can see what the saw is doing; convenience in fastening the work on the table; cheaper to construct than an ordinary power saw; can saw out dies; can substitute a file for the saw; has adjustable stroke and variable speeds and feeds. Under these conditions a maximum amount of work is attained at a minimum cost.



A LATHE HACK SAW

Boston, Mass. H. R. GILSON.

Removing Pieces from the Eye

The grinders here in Sheffield have a way of getting things out of the eye that was new to me. Having gotten something in my eye, several tried to locate it but failed, when someone suggested blowing a little finely powdered sugar into the eye. Being rather particular about what goes into that member, I at first refused, but on being assured that it was a common practice among the grinders here, I submitted and was soon surprised to find how quickly the intruder vanished and the pain eased. Even when it is necessary to use the point of a sharp knife to remove the piece, the sugar eases the pain and seems to have a healing effect upon the wound.

Sheffield, Eng. I. PAIN.

Effect of Autogenous Welding on the Metal in the Joint

The many articles that have appeared in the columns of the AMERICAN MACHINIST from time to time on the different methods of welding and brazing iron and steel products have been of considerable interest, and the great development of recent times in this art makes the subject an important one to all those engaged in works where iron and steel products are handled.

It occurs to me in connection with this subject that a report recently published in *Stahl & Eisen* covering a research conducted to discover whether any difference exists in joints welded through the agency of hydrogen and acetylene flames, may be of interest. In the case of iron products the question presented itself as to whether, or not, where a joint had been effected by means of the acetylene flame, a certain quantity of carbon formation does not appear in the weld, thereby rendering the iron at the point of juncture somewhat brittle, and thus having a deteriorating effect upon the weld.

To determine this point a number of samples were taken and plane sections produced by cutting vertically through the welds. These samples were then ground and polished in the ordinary manner. One part which had been etched and treated with an alcoholic solution of picric acid showed, according to micro-photographs taken, that the distribution of the ferrite and pearlite was perfectly regular and even throughout the entire welded portion. When specimens of the welds produced by means of the hydrogen flames were prepared in the same manner and examined, the same uniform and perfect condition existed.

It was thereby shown that the question sometimes raised concerning the impracticability of obtaining a perfect and lasting weld by employing the acetylene flame is without scientific or practical foundation, due to the fact that the separation of the carbon claimed to take place by imperfect combustion of the gases does not exist. The only noticeable irregularity as a result of the research made was the fact that the particles of the slag contained in the iron had lost their thread-like character, which is produced in the rolling of the original plate. These showed in the weld as minute knot-like particles, which were distinguished from pearlite by the color.

Another point often raised, which the experiment seemed to clear up, was the effect of the gases employed in conducting a weld upon the sulphur content of the part welded. It was found, whether using hydrogen or acetylene flames for heating, that the weld was poorer in sulphur than the product itself, although the distribution of the sulphur in the welded part seemed to be more uniform than it was in the original plate.

Brooklyn, N. Y. S. A. FRANCIS.

Industrial Education at Atlanta

The Society for the Promotion of Industrial Education in Annual Convention Discusses Various Phases of This All Important Subject

EDITORIAL CORRESPONDENCE

An additional forward step in the industrial educational movement was made at the Atlanta convention of the National Society for the Promotion of Industrial Education, November 19 to 21. The conventions of the society are, of course, of large and perhaps chief significance as an illustration of the interest which is taken in the subject, and in this respect the Atlanta convention was fully abreast of the previous convention at Chicago. This convention was given a semi-official character by the fact that the opening banquet of Thursday evening was presided over by Governor Smith, who also gave the address of welcome at the session of Friday morning. Moreover, the sessions were held in the Hall of Representatives at the State capitol, which was well filled at all of the sessions. The interest manifested throughout was of the keenest, a fact which is sufficiently indicated by an incident connected with the Friday afternoon session when, late in the afternoon, the electric lighting equipment suddenly failed and left the hall in darkness. This untoward incident did not in the slightest dampen the ardor of the discussion, which was carried on in almost absolute darkness, until the time for adjournment arrived.

There was distinct progress in the papers and discussions toward tangible things, the discoursive and sentimental character of the proceedings at Chicago being relegated to the background while constructive and practical work became the dominant note of the proceedings.

Without attempting to give an abstract of the various papers in serial order, or even to notice all of them, this report will be limited to a statement of the more important things said.

At the opening banquet of Thursday evening the introductory remarks of Governor Smith outlined the condition of interest which is felt in the subject in the South, and especially in Georgia, where considerable progress has already been made in establishing industrial and especially agricultural schools, in which the aim is to develop primary education throughout the State, rather than to center advanced education in a single institution.

Some Pioneer Work

A striking address at the dinner was made by Theodore C. Search, of Philadelphia, who described, in graphic language the early history of the Philadelphia Textile School of which he was the founder 23 years ago. This was the pioneer industrial school of the United States, its origin and its entire support having been due at the start to Mr. Search who was also its first and, for a time, its only teacher. In organizing the school Mr. Search had no precedents to guide him, his only knowledge of such schools being the bare fact that they existed in Germany, and he is entitled to be recognized as the pioneer of this movement in this country. Support came to his efforts through the conspicuous success of his first students, some of whom, after a single year's instruction went back to the mills under double the wages which they had received before entering the school.

Another striking address at the dinner was by E. E. Brown, the United States Commissioner of Education. Mr. Brown opened his remarks by referring to the reputation of the American people as mere dollar hunters, and stated that as a matter of fact they are idealists, supporting his contention by pointing out that for a hundred years our entire system of public education has been conducted without reference to industry but solely from the standpoint of the development of the individual. He pointed out that the keynote of industrial education must be its artistic side, defining an artist workman to be one whose interest in his work is centered in the work, and not in the returns he receives for it, and he declared the great work of industrial education to be a carrying into the factory system of the spirit of pride in the work done that formerly pertained to pure handicraft.

The President's Address

The president of the society, Carroll D. Wright, was unable to attend because of illness, and his address was consequently read by Vice-president M. W. Alexander. Dr. Wright pictured the precarious livelihood earned by the boy who enters life without industrial training who naturally becomes a floater and the condition of these boys has become of grave importance to the country.

He pointed to the growth of the society as an index of the interest which is felt in the subject. State committees have been organized in thirty-eight States of the Union and nine of these committees have been reorganized into State branches. For further effective work a largely increased income is now necessary, in order that the secretary may be a salaried officer and that a commissioner who shall devote himself to field work may be appointed with an adequate salary and means for meeting his expenses. For this purpose he considered $25,000 a year necessary, and he outlined the high order of man necessary for the office of commissioner. He did not regard the society as a permanent organization, or as one having a long period of work before it. On the contrary, its work should be of a short and intensive character devoted to arousing interest and getting the movement under way to a point where it would take care of itself. His idea was that with an adequate sum the work of the society could be accomplished in about three years.

The Apprenticeship System

After the addresses of welcome at the opening session of Friday morning by Governor Smith, of Georgia, and a representative of Mayor Joyner, of Atlanta, a paper was read by E. P. Bullard, Jr., on the topic, "Industrial Training Through the Apprenticeship System," which formed the general subject of the morning session. Mr. Bullard combated the idea that the apprenticeship system is dead, and stated his belief that no system of schools could take the place of shop training. He enlarged upon the scarcity of skilled men, saying that prior to the panic such men were almost unobtainable. He believed it to be an average experience that when enlarging a factory force it is necessary to hire and try out five men in order to obtain one suitable for the work, and he proceeded to outline the expense involved in thus trying out men, most of whom are found incapable—an expense which he believed would go a long way toward providing apprentice training. Against the scarcity of skilled help he placed the fact that inefficient and unskilled help is always plentiful, and he believed that properly organized apprenticeship systems would do much to correct the existing conditions.

He pictured the constant feeling of discouragement of the common laborer over the lack of opportunity for his children who must in the nature of the case become wage earners at an early age. He outlined a careful inquiry which he had caused to be made at the works of the Bullard Machine Tool Company into the comparative cost of the same pieces of work when done by journeymen and apprentices, the cost of 1000 such pieces having been collected by the cost-accounting department. These had been analyzed and compared with the addition of the proper burden figured on the hourly burden plan, and

the work of the apprentices had been found to be appreciably cheaper than that of the journeymen. This inquiry had been undertaken because the directors of his company did not believe apprentice labor to be profitable, or that the works could afford to employ apprentices, and the result of the investigation has been to change this belief. He considered it necessary that the apprentice should be paid sufficient wages to provide for his support, that he should be given instruction in the technique of his trade, that an adequate amount of class-room instruction should be provided aiming directly at the work of the shop, and that especially the apprentice should be taught the care of expensive factory equipment. The foremen should not be relied upon to teach apprentices, but a special shop instructor should be employed, as foremen have too many responsibilities and cares to make it possible for them to teach the apprentices.

Returning to the matter of care of factory equipment, he stated his belief that 90 per cent. of the repairs required for metal-working machinery are due to the negligence and ignorance of their operators. He referred to the apprenticeship system of the National Association of Machine Tool Builders and exhibited the diploma of the association, which is awarded to boys on the completion of their apprenticeship course.

Mr. Bullard was followed by M. W. Alexander, who began by saying that a properly organized apprenticeship system is nothing but a trade school in a factory. He described the shop and class-room work necessary for a complete course of apprenticeship, and showed how, while large factories may look after both sides of the subject, small ones should combine their efforts in class-room work. He had little faith in trade schools pure and simple, but believed that apprentices should be trained under conditions approximating as closely as possible those which will surround them later, and that they should be given nothing but commercial work to do. He believed that the initial wages paid should not be less than $4 a week. As a matter of fact, the General Electric Company at its Lynn works pays $5.

The class-room work should be done during working hours, and for the time so spent the boys should be paid their regular wages. He had no faith in the general success of a plan which required the boys to attend school during the evening after a full day's work in the factory.

He regarded the age of 16, which is the customary one at which factories will accept apprentices, to be unnecessarily old, and believed that in many cases the term may properly begin at the age of 15, and in this connection he enlarged upon the necessity of bridging the gap between the time when statistics show that the majority of boys leave school and the time when they begin productive work—this period when spent as it frequently is having a demoralizing effect of the most serious character.

Trade-school Experience

Another paper of more than ordinary interest was read by John A. Shrigley, president of the Williamson Free School of Trades. Mr. Shrigley spoke from the standpoint of an experienced man in the conduct of a trade school pure and simple, and one which is based upon the fundamental idea that the work of the student shall be exercise work, and not offered for sale. He thoroughly believes that this is the proper system, and fortified his belief by reference to the experience of his own school. He declared that the sale of the work is not necessary in order to insure the student's interest—his experience being that the interest manifested is increased by the fact that it is done for the benefit of the students alone, and he did not believe it right to conduct a trade school as a competitor of legitimate business enterprises. Moreover, capable and satisfactory workmen may be turned out on exercise work, their records showing that as high as 90 per cent. of the graduates of their classes started work immediately as journeymen and at satisfactory wages, many large employers in the vicinity of Philadelphia taking all of the boys from the school that they could get, and the progress of the boys after graduation being eminently satisfactory. He regarded the age of 16 as being as early as boys should be given the tools of men. He regarded 17 as still better, and 18 as not too old. He remarked that boys on graduation should have the appearance of manhood in order to get men's pay. He believed that there is no limitation to the trades that can be successfully taught in trade schools.

He regarded it easier to teach trades than professions in schools. In periods of normal business activity his school is not able to meet the demand for his graduates, and after 21 years' experience as a manufacturer and 20 as an educator he asserted without hesitation that it is entirely practicable to have the trade school course so thorough in practice as well as in theory, that the graduates will be at once qualified to work as journeymen.

He referred to the German schools of which we hear so much, and stated his belief that there is a pronounced tendency to under rate the work of American schools in comparison with those of Germany. The great feature of German schools is the attitude of the public toward them, together with their scope and extent. Considered on their merits he did not regard them as at all remarkable, or that there should be any difficulty in obtaining just as good results in this country, although of course, the methods and organization could not be the same.

Trade Schools for Girls

The subject of trade schools was also discussed at length, in a paper by Florence M. Marshall, director of the Boston Trade School for Girls.

Without indulging in any foolish compliments, it is the simple fact that Miss Marshall's paper proved to be one of the best read at the entire convention. She outlined the conditions in which young women find themselves and the preponderating percentage of those who in many localities find it necessary to engage in wage earning occupations and pointed out that many lines of work are dependent on woman's skill. She took direct issue with Mr. Shrigley, regarding the desirability of the sale of the product, which she regarded as not only highly desirable but even necessary in order to recover the cost of expensive materials. Moreover, the fact that the work must be acceptable to and conform to a standard set by others, is an important factor in determining the attitude of the pupils toward the work.

The opposite views of Mr. Shrigley and Miss Marshall on such a fundamental subject were widely commented upon, especially as each is distinctly, and perhaps equally, successful in arriving at a common end. With the experience of the two before us, one must recognize that after all the personality of the teacher and not the method followed is the determining factor.

Evening Schools Discussed

Louis Rouillion, director of the educational work of the Mechanics' Institute of New York, advocated evening schools, saying that in Great Britain the evening vocational schools are wielding so large an influence that all attempts at day training are almost eclipsed. In this country by far the larger amount of real vocational training that is definite and effective, is being done in the evening schools.

The evening school does not interfere with the pupil's present earning capacity, nor with his hours of labor. It only asks for some of the time that would otherwise be lost in idleness or in the pursuit of amusement. It has a decided advantage in that it does not have to force or urge a boy to select this or that trade, but finds him already employed as a plumber, a mason, or a carpenter, with his ambition aroused to excel in his trade. The mere fact that a lad elects to attend an evening school puts him in the select class of the actively ambitious. This is one reason why the tone of the evening trade schools and mechanics' institutes is pitched to a higher and truer key than obtains in similar day-school work. The earnestness and intensity of purpose of these students is a well attested fact.

Much talk is heard about the self-sacrifice and hardships in a boy attending evening school after eight hours' labor at his trade. Anyone who has had to do with evening-school work knows how mis-

placed is such sympathy. The school work is seldom a burden to the student; in most cases it is a real pleasure. The reaction upon him is not one of exhausting his nervous vitality, but quite the contrary.

He believed that evening schools will, undoubtedly, be the solution of the problem that will be the most generally accepted in the immediate future and that it is along these lines that we may look for the major part of all real vocational training.

The Position of Organized Labor

Leon C. Sutton, editor of the *Labor World*, urged the point of view of the wage earner, saying that to some few manufacturers in the United States who want to have educated, at public expense, young men and young women, who, upon their graduation from an industrial school, can be used as a club to lessen the rate of wages or can be used as strike breakers, an effective system of industrial education means one thing. To the wage earner, on the other hand, who wants to have his children taught better than he was taught, it means something far different. He wants the children taught not merely dexterity of hand but in addition the theory of mechanics, the reading of blueprints and the use of tools, also the history of commerce and of the ancient guilds, the origin and growth of trades-unionism, the story of the struggles through which it has gone, something of what real true unionism means in the betterment of the men and women of our country today, so that after their years of study in the industrial school they do not come forth with their diploma to eat up their fellow human beings by inferior work at lesser wage during longer hours and thus be an aid in undoing just what trades unionism has struggled so long and earnestly to win.

He believed that in any effective system of industrial education from which the wage earner is to derive a benefit, organized labor must have a part. The young men and the young women educated in the various handicrafts which they have chosen in the trade schools, will be either the friends or the enemies of organized labor.

The pedagogue sees in theory the value of such a training, the manufacturer sees the value of its productiveness, the trades unionist sees its human side. He remembers his trials and sacrifices and he goes with natural caution, but admit him to his proper place among the boards of control and among the practical instructors, give due weight to his advice and then his attitude of suspicion will be turned to one of cordial coöperation.

The Business Session

The business meeting opened with the reading of the reports of the secretary and treasurer, the former showing an active membership of about 1000, and the latter an empty treasury. The by-laws had been found to be unworkable, and on motion they were suspended pending their review.

The committee on resolutions brought in a resolution recommending that the Government Bureau of Education become a department of education with its secretary a member of the President's cabinet, and, pending such a radical change, the appointment of two deputy commissioners, one devoting his attention to industrial and the other to agricultural education. Another resolution created the office of commissioner of the society and directed the board of managers to use every effort to raise an adequate sum by subscription or otherwise to enable the society to engage in an active propagandizing program. These resolutions, together with the customary resolutions of thanks to the local committee and the citizens of Atlanta were adopted.

The committee on nominations brought in the name of Alexander Humphreys, president of the Stevens Institute of Technology, as president, Walter C. Kerr, of Westinghouse, Church, Kerr & Co., as vice-president, and F. B. Pratt, as treasurer, and these nominees were duly elected.

F. A. H.

Cutting Up High-speed Steel

The Fellows Gear Shaper Company, of Springfield, Vt., uses up a large amount of steel in making cutters for its gear shapers, and as the use of high-speed steel increased, the amount of metal lost in the cutting became a serious item.

So Mr. Fellows rigged up a hack saw, as shown in Fig. 1, with a frame to carry nine saws, drove them with the speed-reducing gear and crank shown, and also rigged up a device for revolving the stock at the same time. This is simply a worm-gear arrangement that turns the stock, this being necessary to insure square or parallel cutting of the sides of the cutter blank.

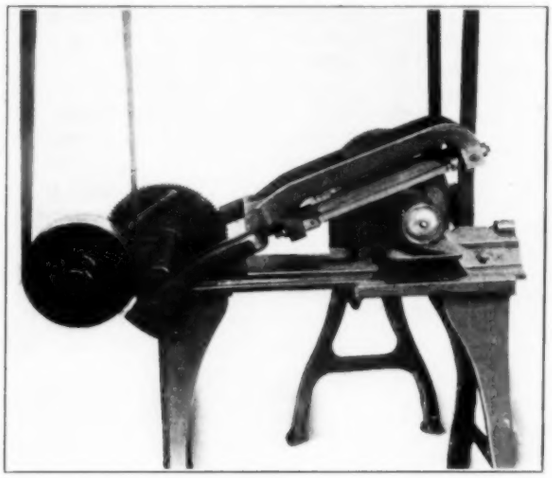


FIG. 1. HACK SAW WHICH REVOLVES THE STOCK

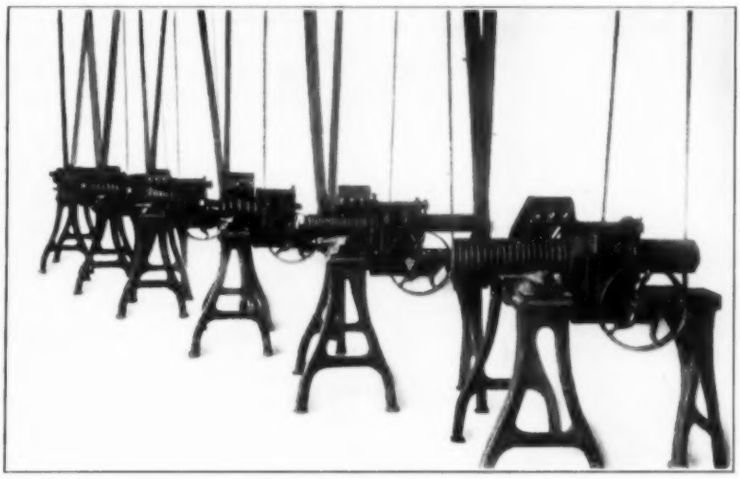


FIG. 2. THE MECHANISM FOR TURNING THE STOCK

The saw does not cut entirely through, but is stopped at a point that allows stock enough to hold the pieces together and at the same time allow it to be easily broken apart after it comes out of the machine. This is of great advantage in working up the last end of a bar, as by reversing the bar, putting the end already cut into the chuck, the uncut end is revolved out in the open and the last end can be cut up as easily as the rest, doing away with any waste from this source.

The details of the saw can be seen in Fig. 1, while Fig. 2 shows the worm-gear mechanism for turning the stock. This view also shows the battery of saws, which gives some idea of the amount of stock cut up, as well as the total saving in the waste by cutting.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1907 *we printed and circulated* 1,151,500 *copies of the* AMERICAN MACHINIST. *Our circulation for November,* 1908, *was (weekly, monthly and European)* 90,000.

December 3..... 33,000

This paper reaches 33,000 *separate readers each month and* 19,250 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Aluminum—Now an Ordinary Commercial Metal

The prediction has been made repeatedly that aluminum would soon become one of our ordinary commercial metals, and that its use in the arts would be extended to such an extent that it would become a formidable rival, in certain fields, of copper, copper alloys, and even iron and steel. The first part of this prediction seems about to come to pass, even if we are not justified in saying that it has already come to pass.

At the beginning of this year the producers in Europe, still bound together by the terms of a convention, reduced their price from 33 cents per pound to 22 cents per pound. Decline in the demand by consumers was the leading factor in this reduction. At about the same time, the American producer reduced its price from 38 cents per pound to 33 cents per pound. Previous to the panic of 1907 the American price was 42 cents per pound. It has been the policy of the Aluminum Company of America to make the price for its product all that the trade would bear. Toward the end of 1907, however, the demand having dwindled to a comparatively small amount, the company made a rather grudging concession in price.

On September 30 the convention among European producers was dissolved, and immediately there was a scramble for business in a market which had suffered severely by the enormous falling off in orders from automobile manufacturers and from the competition of ferro-silicon in the iron trade. Aluminum immediately passed upon the footing of the staple metals like copper, lead, tin and zinc, wherein there is free competition and the establishment of prices in which the buyer, as well as the seller, has a part. The price for aluminum in Europe fell, consequently, to as low as 13½ cents per pound, which price rules at present. The American producer is protected by a duty of 8 cents per pound upon ingot aluminum, but in spite of that duty the slump in Europe was so great as to compel successive reductions in price here. The last quotation was about 25½ cents per pound, but probably considerable discounts from that price are made to well informed customers, inasmuch as high-grade European aluminum is freely offered here at 22 cents per pound.

The present price puts aluminum on a basis comparable with those of tin and copper. Weight for weight it is cheaper than tin, but bulk for bulk it is cheaper than either tin or copper. This level of price ought to stimulate greatly the consumption of aluminum, especially when the revival of general trade has gone a little farther. The producing capacity of Europe is increasing, while in the United States the Bradley patent will expire early in 1909, permitting free competition in the business here, just as there is now in Europe. Thus another year at least will put aluminum so that it can be classed, without the possibility of question, as an ordinary commercial metal. It now remains to watch with interest the new uses to which it will be put, as well as the increase that will take place in lines of production where it is now considered as a necessary metal.

National Council of Commerce

As the first annual meeting of the National Council of Commerce is to be held in Washington, D. C., in the early part of this month it is fitting to review briefly the inception, organization and first year's work of that important commercial body. The formation of this council stands as a monument to the constructive genius of Secretary Straus of the Department of Commerce and Labor.

After Secretary Straus had developed the organization of his department, he turned to the problem of making it of greater service to the commercial interests of the country, of establishing greater coöperation between the department and such interests and of obtaining from them an expression of such desires and needs as could be considered and acted upon properly by his department. On December 5, 1907, the secretary called together a meeting of delegates from representative commercial bodies throughout the country. In his opening address he outlined the purpose of the conference, and suggested a tentative scheme for the formation of a National Council of Commerce, which should be a permanent organization representative of the commercial interests of the United States and coöperating with the Department of Commerce and Labor and such other departments of the National Government as would be aided thereby.

That such action by the secretary of the Department of Commerce and Labor was directly in line with the provision of the organic act by which the department was created is shown by the following quotation from that act: "It shall be the duty of said department to foster, promote and develop the foreign and domestic commerce in mining, manufacturing, shipping and fishing industries, the labor interests and the transportation interests of the United States.

In order that such a conference and council shall be of value its functions and actions must be kept entirely outside of the field of politics or partisan action. Its functions must be administrative not legislative. This point was emphatically set forth by the secretary in the following words: "The purpose of this conference is administrative not legislative. This department is not charged with matters relating either to finance or revenue nor with the administrative duties respecting the tariff or reciprocity."

Touching upon the points of the service which such a council could be to other departments of the Government, we quote further from the address of Secretary Straus as follows: "I see no reason why such a national council and advisory committee should not extend its coöperation to other executive departments that touch the commerce and manufactures of the country, such as the Department of State, the Treasury Department and the Department of Agriculture." And again from an address by Secretary of State Root: "The State Department becomes interested at the point where the efforts of our people to organize and increase their foreign commerce touch foreign conditions, and it is plain to me that there are many things which should be done and which can be done only through organization and through the power of associated effort. There are things which will not be done by separate individuals each following along the line of his own business."

Such was the inception and preliminary outline for a national body which should coöperate with the great departments of our National Government. Permanent organization by the delegates took the form of a National Council of Commerce and, appointed by it, An Advisory Committee. The council was to be composed of one representative from each of the leading commercial and industrial organizations representing the principal lines of commerce and manufacture in every section of our country. An annual fee of $100 was required for such membership. The Advisory Committee was to be selected by the National Council and was to consist of 15 members. This committee was to meet as often as required and was to act as an intermediary between the department and the industrial interests of the country. Such is the scheme of organization. All of the bodies that sent a representative to the preliminary meeting were enrolled as charter members. The work throughout the past year has been educational, directed to building up the membership of the council. It is estimated that there are nearly 800 organizations in the country which are eligible for membership. At the time of this writing, the council has 44 members with an expectation of having this number increased to at least 50 by the time of the forthcoming meeting.

It is pleasing to note the action taken by the Machine Tool Builders' Association at its last convention whereby it is to become a member of this council.

Along the lines of the broad work that the council is to perform, three matters have been taken up during the past year. Under date of February 6, Secretary Straus sent a communication to the Advisory Committee requesting information and suggestions on three points which were: The appointment of special agents abroad—agents for the investigation of foreign industries and markets; the utilization of exhibitions abroad for the promotion of our foreign commerce—several expositions were held in various parts of the world during the current year, and the proposed tariff negotiations with France—requesting particularly information as to what restrictions and treatment our exporters meet with at the hands of the French customs authorities.

On June 19 a bulletin was sent out by the chairman of the Advisory Committee asking for suggestions in regard to the industrial investigations that were being prosecuted abroad. That bulletin contained the following paragraph quoted from a letter of Secretary Straus. "The attention of the Advisory Committee of the National Council of Commerce is respectfully invited to the service that is being performed through the bureau of manufacture of this department in investigating trade conditions abroad and with the object of promoting the foreign commerce of the United States. Investigations are now in progress in regard to agricultural machinery and implements; machines and machine tools; cotton fabrics; cotton-seed products; and cereals, especially wheat and flour. In each of these fields an expert is employed whose appointment was made upon recommendation of organizations representing the several industries. The results obtained have been highly satisfactory to the department and to those for whom the investigations are being especially made. While no assurance can be given that other industries will be taken up for investigation during the coming fiscal year, it is suggested that the Advisory Committee invite the attention of the constituent members of the National Council in this matter."

On June 20 another bulletin was sent out requesting suggestions concerning our commercial relations with foreign countries. This followed a request from secretary Cortelyou of the Treasury and from his communication we quote: "I shall be very pleased to get from the committee and from the business men and interests of the country, all the information possible as to how American exporters and exports are treated by foreign nations. There is always a great deal of complaint on the part of other nations as to our customs and our regulations, and undoubtedly these matters will be pressed vigorously when any revision of the tariff is made, with consequent changes in the customs administrative acts. The organizations in the National Council of Commerce could get very valuable information based upon practical experience as to what they had encountered abroad and this would be in many ways of great assistance to this department."

These requests but hint at the possibilities for good that lie in this commercial organization. Suggestions regarding routes of trade, the establishing of American banking facilities abroad, discussions of commercial treaties, the compilation of statistics with regard to foreign markets and trade, and the dissemination of information in regard to foreign customs regulations, appraisings and rulings are but a few points upon which action might be taken.

It should be pointed out that the strong commercial nations of Europe have organizations that aid the commercial interests of their countries along similar lines. Germany in particular has a most active, semi-official organization, whose members are paid by the Government, have a residence in Berlin and act in an advisory capacity on all questions that affect the commercial and industrial life of the Empire.

We expect great good from the establishing of this council and from the work it will do in the years to come in promoting American commerce. If it measures up to its possibilities, it will stand forth as one of the great achievements of the secretaryship of Mr. Straus.

The Working of Patented Inventions

Now that the elections are out of the way, two subjects of prime importance to manufacturers confront them in connection with the forthcoming session of Congress. These are, of course, the revision of the tariff and the proposed introduction of a compulsory working clause into our patent laws.

Our readers will recall the discussion which we gave on this last subject during the last session of Congress, in which the heavy pressure that was brought to bear, and which will doubtless reappear this winter, in favor of a compulsory working clause, was set forth.

The strong feeling in favor of a compulsory working clause is the direct outgrowth of the existence of such clauses in the patent laws of European countries and is prompted by a perfectly natural desire to retaliate. The hearings held by the committee on patents made it plain, however, that all measures which have so far been suggested are full of danger and difficulty and likely to produce far more harm than good, but as the situation stands the demand for retaliatory action is so strong as to introduce great danger of precipitate and unwise action unless the interests concerned bestir themselves.

In this connection we desire to call particular attention to an article by Dr. Alfred Muller, who is well known to many of our readers, which will be found in another column, in which he states his belief that by proper action the Government can bring about the repeal of existing compulsory working clauses in European countries, and there is no question that if this can be done the outcome will be in every way far more satisfactory than any result which is possible from a piece of retaliatory legislation. We hope no reader will fail to pay attention to Dr. Muller's article.

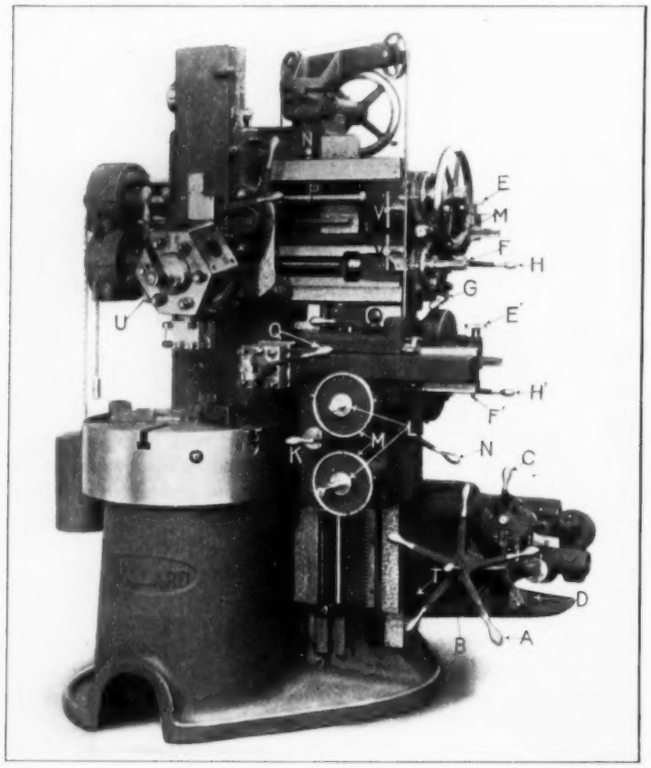
New Tools and Machine Shop Appliances

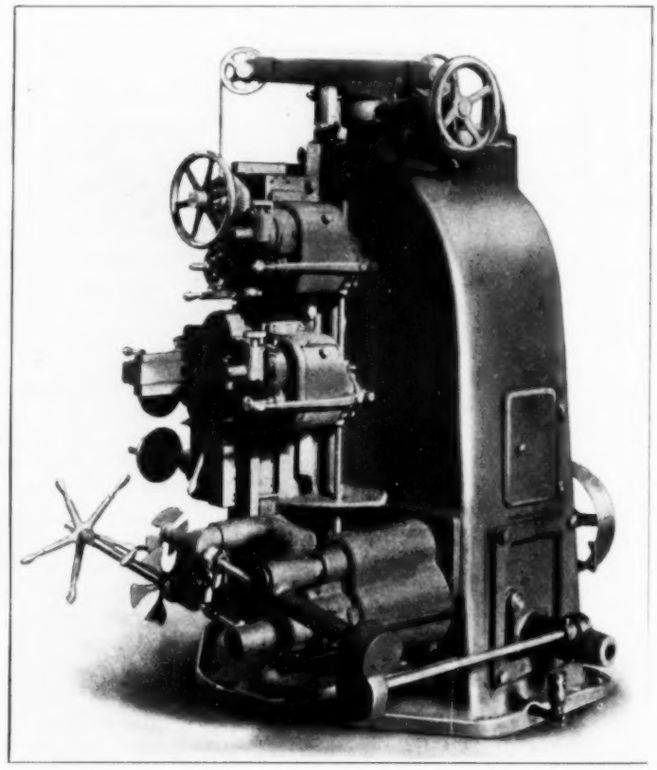
Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A 24-inch Vertical Turret Lathe

The success of their 36-inch vertical turret lathe has led the Bullard Machine Tool Company, Bridgeport, Conn., to bring out a 24-inch machine containing all the useful features of the other. Its small size has opened up a new field of usefulness and it is proving itself a great producer on work within its range.





FIGS. 1 AND 2. TWO VIEWS OF 24-INCH VERTICAL LATHE

The front and rear views in Figs. 1 and 2 are very similar to the large machine, the feed drive at the back being through spiral instead of bevel gears as before. The interlocking device for the speeds and feeds is retained as are the fifteen rates of speeds, the brake for table, the rapid traverse attachment and other convenient features. This is particularly noticeable because there is a tendency to omit this from small machines but, while the weights to be moved are less the tendency to leave gibs looser than they should be is the same, resulting in chatter and vibration.

Referring to Fig. 1, *A* is the pilot wheel controlling the changes in the speed box. This can only be engaged with the upper spoke in a vertical position and each spoke represents a different speed. Handle *B* lifts the pilot wheel, but this can only be done when the spoke is in a neutral position and the friction clutches are out of contact. The positive clutches in the headstock are operated by *C*, which thus positions and forms part of the interlocking system. The opening shows the speed and this can only be changed when the speed box is disengaged and the brakes set. The interlocking disk *D* is connected to the same shaft as the pilot wheel. This also carries the numbers showing the table speeds, the one in operation being indicated by the small arrows.

The feeds are independent for each head, handles *E* both operating sliding racks shown in more detail in Figs. 4 and 6. Each head has eight feed changes, indicated by the position of the ends of the rack. The clutch rod *F* below gives either the slow or fast series, while the lever *G* throws the worm into mesh with either the cross or vertical feeds of the slide and turret. The webs of the worm gears are held between two friction plates which can be adjusted to slip at any desired pressure so that no harm can be done by running the head or slide to the end of the travel. The traverse of both head and slide are controlled by the handle *V*. Lever *H* reverses the direction of either feed, while *K* engages either the vertical or crossfeed of the side head according to its position. In neutral position either can be moved by crank on *L*.

Index dials *M* are adjustably mounted on each feed rod, and indicator clips are used in preference to solid stops. Handles *N* and *O* are convenient binders, while *P* locks the turret and *Q* is a binder and lock for side-head tool post. The turret can be run beyond the center by throwing out the stop block with the handle *U*.

Figs. 3 and 4 show the gearing for cutting threads or scrolls, the open box in Fig. 3 exposing the single-tooth clutching mechanism which prevents splitting the thread. The drive is direct through the feed box, the gearing making the motion of the clutch shaft 1 to 1, or even with the table.

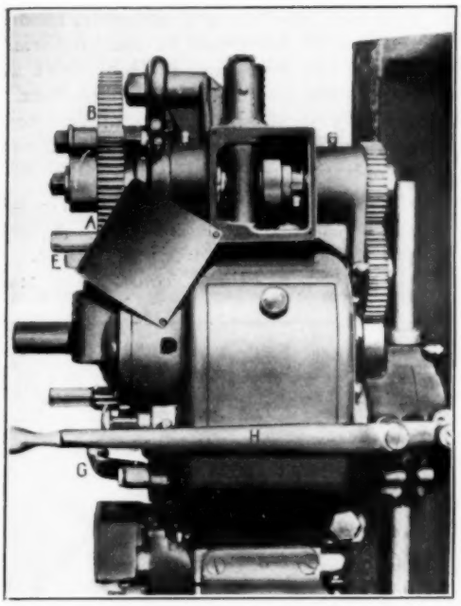


FIG. 3. CLUTCH FOR THREAD CUTTING

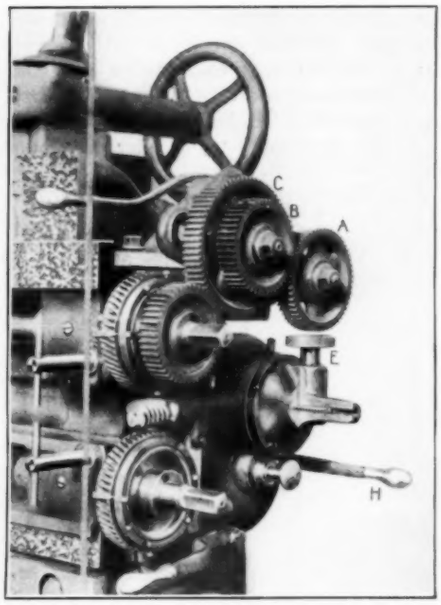


FIG. 4. GEARING FROM FEED BOX FOR THREAD CUTTING

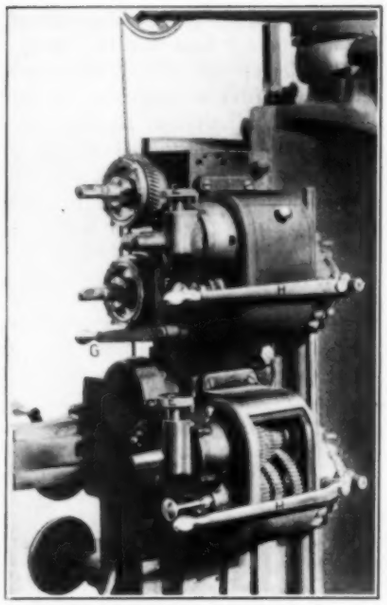


FIG. 5. FEED BOX WITH COVER REMOVED

Counterweighting of the Turret

The clever counterweighting of the turret slide by an independent pinion in the same rack as the power pinion, is retained in this as well as the system of gibbing the slide which allows perfect alining at any time.

Fig. 9 shows the speed-box gears, the clutch rod which goes inside the hollow shaft and one of the gears to show the clutch inside. The spider is keyed to the shaft, the chrome-nickel lever which expands the clutch being moved by the pin which is actuated by screw-pins in the clutch rod. Any clutch can be adjusted by taking out the rod and moving the screw controlling that particular clutch without disturbing any of the others.

Figs. 7 and 8 show the 24-inch mill at work on an automobile flywheel, and is a good object lesson in the arrangement of tools. They also show how the side head can be used for facing as well as turning.

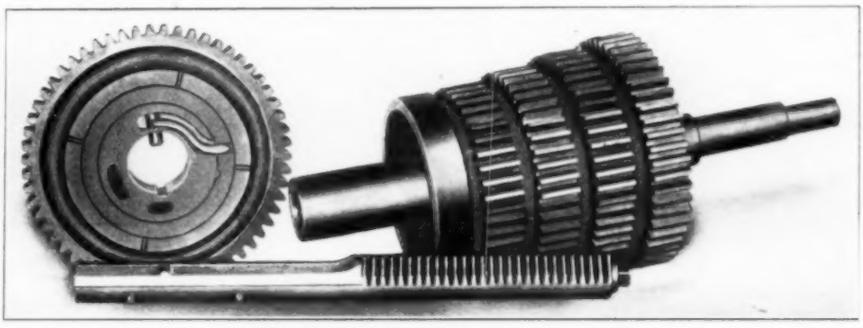


FIG. 9. CONE OF GEARS AND DETAILS OF CLUTCH

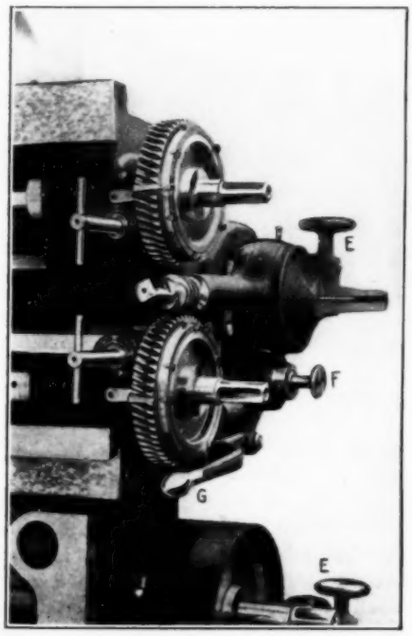


FIG. 6. FAST TRAVERSE AND INDICATOR STOPS

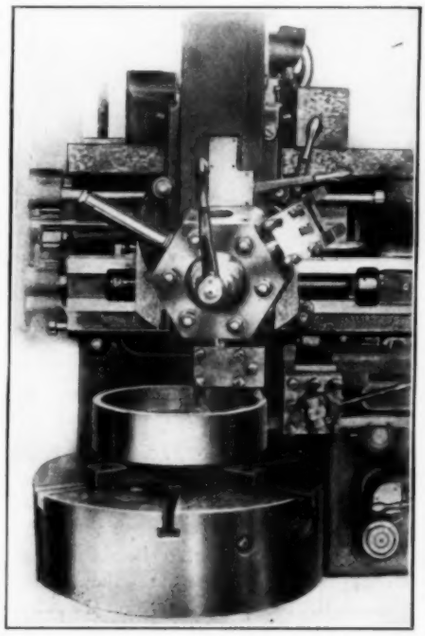
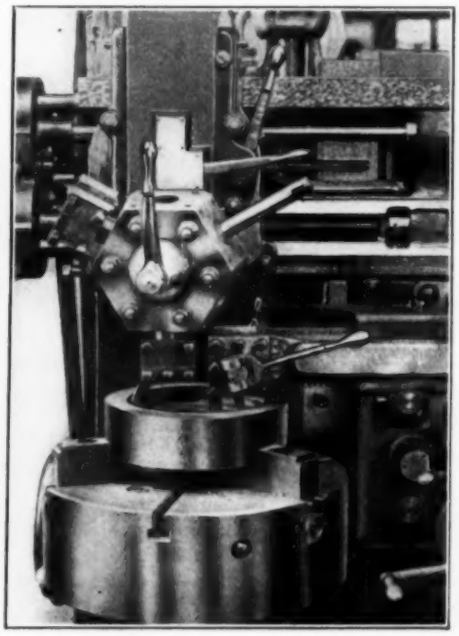


FIG. 7



MACHINING AN AUTOMOBILE FLYWHEEL FIG. 8

Among the new features in this machine are the broader base and the heavy support to lower end of the table spindle; the new friction-engaging mechanism which allows individual adjustment; narrow guide bearing for all sliding parts; cross- and side-rails being a unit on one continuous, narrow bearing, to maintain alinement; the center stop which allows running by the center, yet forms a positive stop at the center when desired. The side-travels 19 inches vertically. It weighs 7800 pounds.

The details of construction were so fully illustrated with the 36-inch mill that we must refer readers to page 480, Part 2, Vol. 30, (1907) for a fuller description.

The Poole Boring Mill

The J. Morton Poole Company, Wilmington, Del., has improved its line of boring mills so as to be thoroughly modern in every particular. Fig. 1 shows a machine equipped with a boring head and arranged with tools for turning out rope-drive pulleys. Fig. 2 is the other side of a mill with the two regular heads and shows the operating levers on the side. The two right-hand levers control the clutches that operate the table drive, as shown in detail in Fig. 4, the others handle the vertical movement of the cross-rail, feed of the heads and the tool slides as well as the fast traverse for them both.

Fig. 3 shows the details of feed-box gearing, all levers being grouped for ease of operation.

These mills are made in 7-, 8-, 10-, 12- and 14-foot sizes, requiring 12, 15, 25, 35 and 40 horsepower when electrically driven.

The bed is of box construction and rigidly braced with internal ribs to withstand all strains. The uprights are securely bolted to the bed, properly doweled and connected by a stiff cross-brace at the top. The table is very heavy and is supported by a flat annular bearing of exceptionally large diameter, and wide face, immersed in oil, and provided with a number of tee-slots.

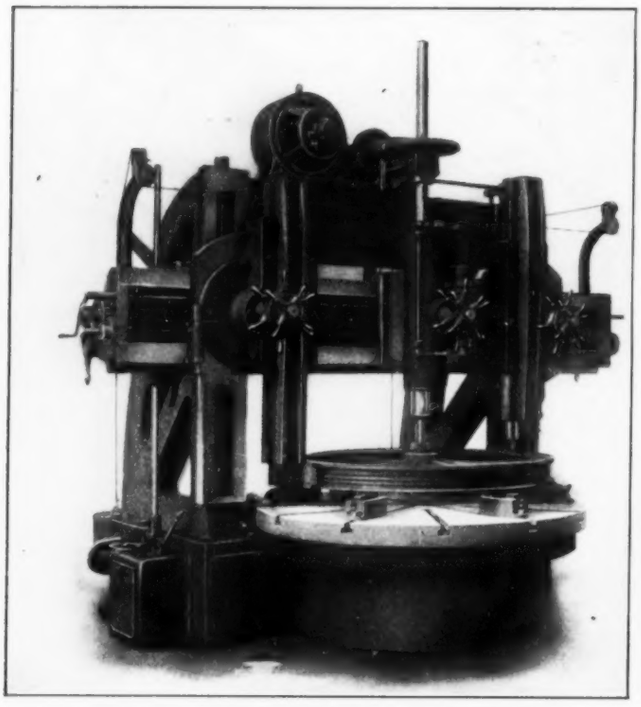


FIG. 1. MILL EQUIPPED FOR GROOVE PULLEYS

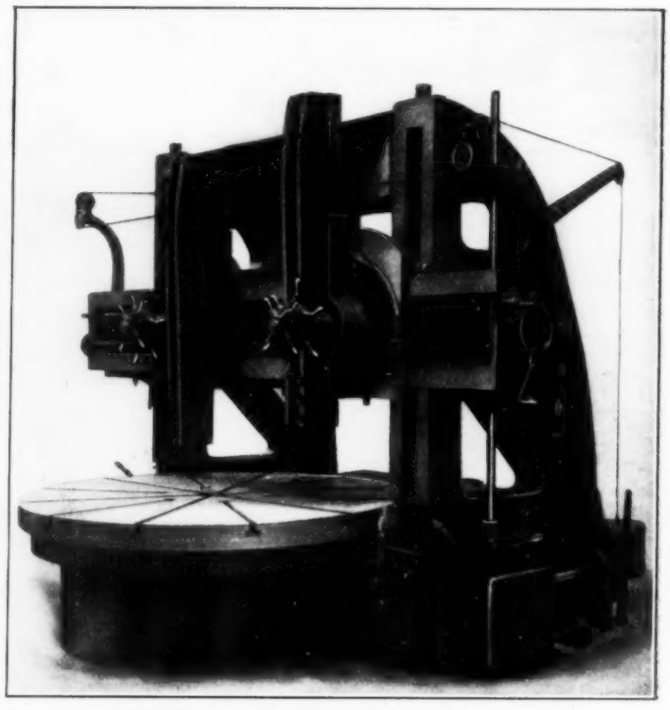


FIG. 2. THE REGULAR EQUIPMENT

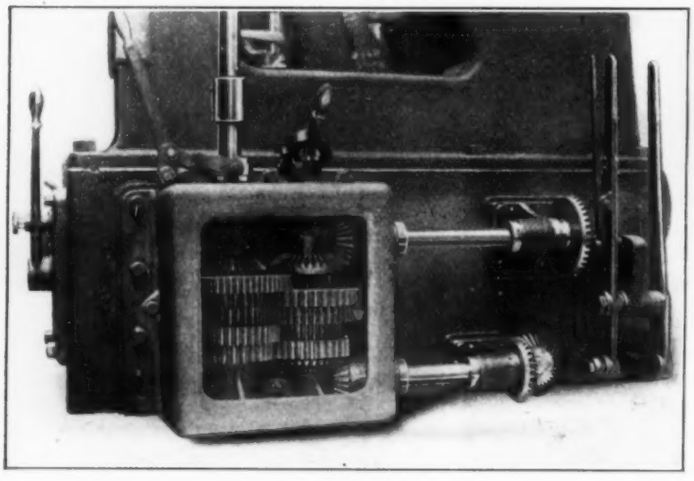


FIG. 3. FEED BOX GEARING

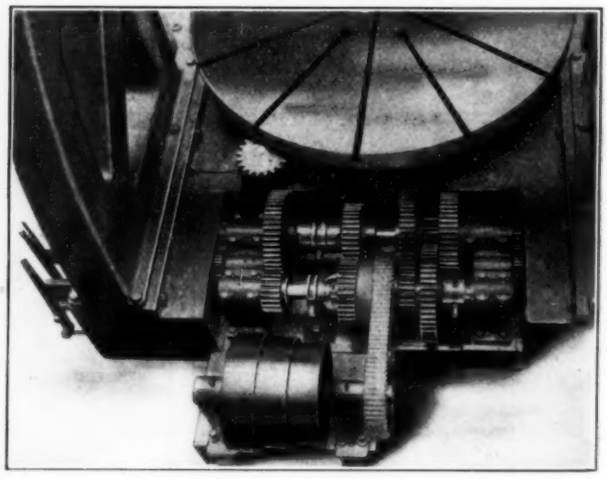


FIG. 4. GEARING OF TABLE DRIVE

head turret is now locked by a cam, being forced away from its seat by a spring, and is more convenient in every way.

This machine has a capacity of 26 inches in diameter, 18 inches in hight and will swing 26½ inches under the turret face. The vertical head moves 18 inches and will face 26 inches. The side head has a horizontal movement of 13 inches and

The belt-driven machines have a three-step cone with a wide face; a silent chain transmits the power from the cone pulley shaft to the back-gear shaft. Four back-gear ratios are provided, and with two speeds of the countershaft, giving twenty-four table speeds. By removing the two caps at each end of the shafts the entire gearing can be removed, without dismantling the mill. The shafts do not project the full length across the bed. All gears in the back of the machine are well protected with a heavy gear cover which can be removed very easily.

By removing the cone a variable speed, 2 to 1 motor can be attached, and by the use of a silent chain the mill can become electric driven. The housings and all top work can be removed and the table operated with the same number of speed changes so that a sweep could be placed on the table and large castings bored.

The spindle is ground on dead centers, is securely bolted to the table; is carried in two bearings of large diameters and provided with taper bushings, with adjusting screws to take up the wear, and is supported in the bed by the use of a heavy lower bonnet.

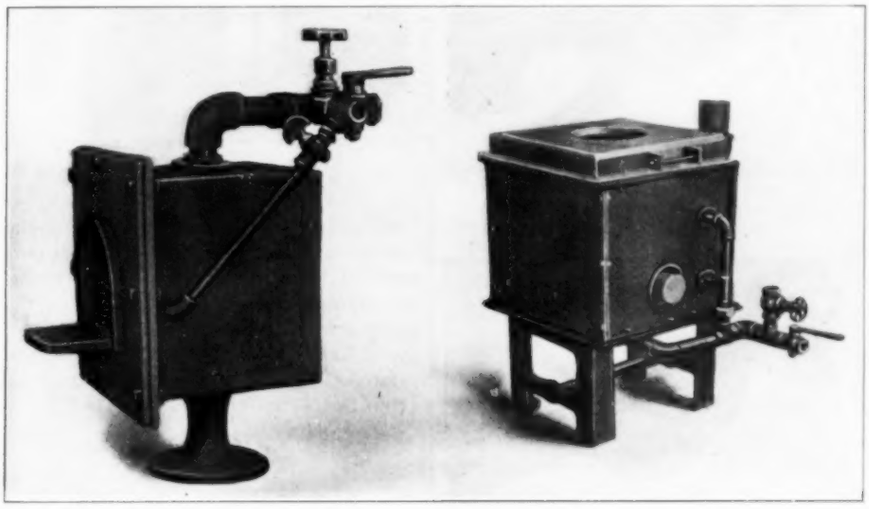
The main rack or gear ring is as large as possible in diameter and of heavy pitch, securely bolted to the table, and driven by a pinion of 20 teeth. All other gears in the main drive mechanism are of steel.

The crossheads, cross-rails and tool slides are handled entirely by power in both directions. The rapid traverse shaft is driven by spur gearing from the intermediate back-gear shaft in both motor- and belt-driven machines. It is impossible to throw in the traverse and back feed at the same time.

The crossheads are entirely independent in their movements, both as to direction and amount of feed; each one can be brought to the center for boring. The slides are very stiff and are separately counterbalanced by weights on each end of the rail, each slide being equipped with a forged-steel square tool bar, secured by binding screws and a set screw. By means of a swivel worm, the heads can be set at any angle up to 50 degrees in either direction.

The feeds range from 1/40 to one inch per revolution of the table, are positive and entirely independent both in amount and direction, and can be easily obtained without stopping the mill. All gears in the feed box are either cast iron or bronze, of a very heavy pitch, and wide face, and strong enough for all practical use.

All of these mills can be furnished for threading and drum-scoring, key-seating and slotting, traveling or stationary head with revolving spindle, or special attachments when desired.



FIGS. 1 AND 2. BENCH FORGE AND CRUCIBLE HEATER

Gas Forges and Furnaces for Various Work

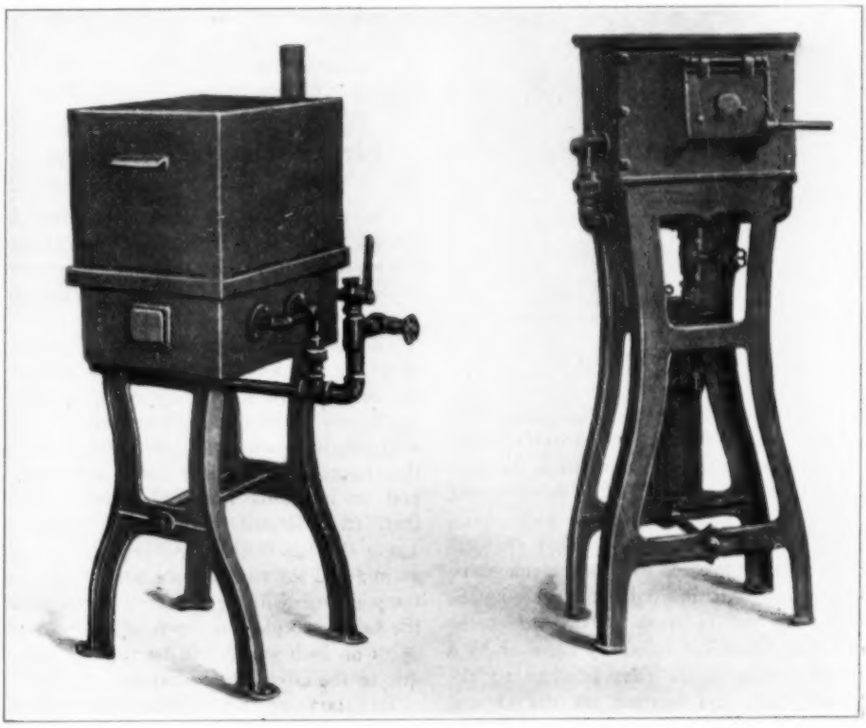
First in the line of the United States Gas Furnace Company, Providence, R. I., is the small bench forge, shown in Fig. 1. This is adapted for forging and dressing and hardening small carbon-steel tools and will handle the inserted cutters of high-speed steel up to ⅜ inch square. There is a small pilot light so that it may always be ready for use and a removable back plug makes it easy to heat any desired point in a long bar.

The furnace shown in Fig. 2 is for all around work in carbon steels. The tool to be heated rests on a slab, out of the direct heat, in what is known as an oven or semi-muffle furnace. This is made in four sizes from 6x8 to 11x18 inches in the heating spaces. A somewhat similar furnace is made for high-speed steel.

Fig. 3 is a furnace for heating crucibles in which lead or cyanide can be melted. When used for cyanide a hood is fitted to carry away the fumes. Larger sizes are made round. For heating barium or other compounds for high-speed steels more burners are introduced, but the same general design is followed.

For drawing the temper, either in oil, tallow or lead, the furnace shown in Fig. 4 is advised, the cast-iron box holding the material to be heated.

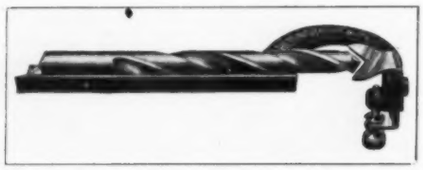
In all these furnaces the bodies are of cast iron, with as few joints as posible, and these held with through bolts, instead of screws.



FIGS. 3 AND 4. TEMPERING AND FORGING FURNACE

A Handy Drill Gage

The little tool illustrated herewith will be found very handy in grinding twist drills so that both lips will do their full share of the work. It should save time to any shop, and is more convenient and accurate than the gages usually found in

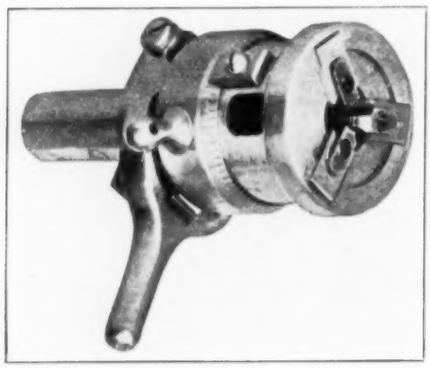


TWIST DRILL GAGE

a machinist's tool box. The lip gage is adjustable for hight so as to bring it in the center of any size drill within its capacity. It is made in three sizes to include 1½-inch drills, by the Remington Tool and Machine Company, 50 Congress street, Boston, Mass.

An Automatic Die Head

The illustration shows a new self-opening die head for use on the turret lathe. The closing ring is outside the die blades and bears upon them over the point where the maximum cutting stress comes. Any wear occurring at this part is taken up by the size adjustment. The die blades are mounted on pivots in the body of the die so that, when they are drawn to-



AUTOMATIC DIE HEAD

gether by the closing ring, the outer ends of the blades, where the heaviest wear occurs, are closed in faster than the portions nearer the pivots, thus compensating for unequal wear.

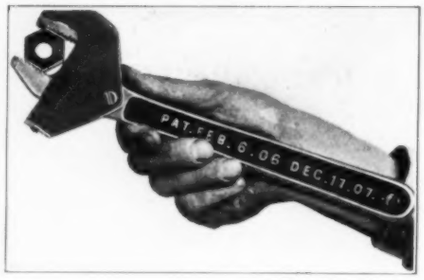
Large openings are provided through which the chips are flushed by the lubricating oil. An internal stop pin trips the die. On the reversal of the turret the die may be closed either by hand or by a small, easily made cam secured to the turret slide and bearing on the closing lever on the backward motion of the turret.

For heavy or rough work, or where two passes over the stock produce better results, a stop is furnished permitting a roughing and finishing cut to be taken. These die heads are made by the Diamond Power Specialty Company, Detroit, Mich.

A New Pipe Wrench

The main claim for this wrench is its quick adjustment to fit any size within its capacity and that it will handle anything in the way of pipe, nuts or lag screws. It is claimed that nothing can

GRIPPING A PIPE



HOLDING A NUT

make it slip after it once gets its grip. It is made by the Webb & Hildreth Manufacturing Company, Gloversville, N. Y.

Electric Hardening Furnace

The furnace for hardening steel that is shown in Fig. 1, is designed to operate on alternating-current circuits, and in it metallic salts are reduced to a liquid state by means of an electric current.

The entire outfit consists of a furnace, of which Fig. 2 is a sectional view through the center, with a hood for carrying away the fumes of the salts; a transformer with a regulating switch; a switchboard with the necessary ammeter and voltmeter; and an incoming line with fuses. With this any desired temperature between 450 and 2450 degrees Fahrenheit can be maintained for an indefinite period and the temperature will be uniform throughout the bath, except to a depth of from ½ to ¼ of an inch which will be slightly lower due to the effects of radiation.

To start up the furnace an arc is started across the broken flux by means of an auxiliary electrode and in a very short time the solid mass is in a molten condition. After the bath has reached its proper temperature, that portion of the material to be hardened is placed entirely in the liquid bath, and is allowed to remain there until it attains the same color as the bath, when it is removed and tempered in water or oil as the case may be.

The bath for hardening or annealing

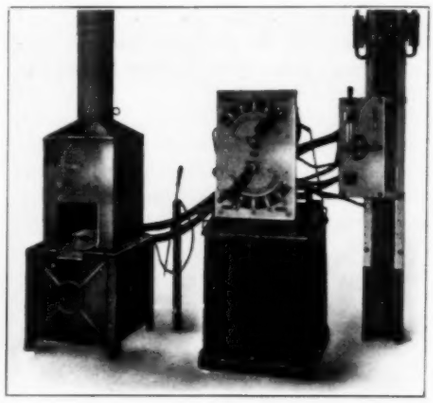


FIG. 1. ELECTRIC HARDENING FURNACE

completely fills the crucible, and in the Schenectady factory consists of equal portions of barium and potassium chloride. The ultimate temperature depends on the relative proportions of the two chlorides, the higher the percentage of barium chloride, the higher the temperature may be carried.

Some of the advantages of this furnace

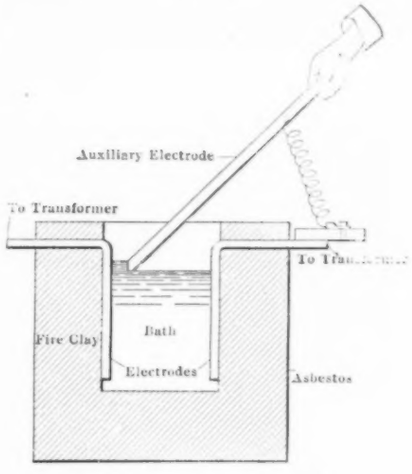


FIG. 2. SECTION OF FURNACE

are: There is no chance for oxidation, for the material while being heated does not come in contact with the air. All parts of the tool are subjected to the same degree of heat at all times, thus preventing strains or overheating. There is practically no danger from fire as the outer walls of the furnace are never hot; in fact when the bath has a temperature of 2400 degrees Fahrenheit, the hand can be placed on the outside of the furnace without being burned. It is so simple and requires so little care and attention that it can be operated by an ordinary workman. The

metallic salts have no effect on the composition of the steel and the operator never comes in contact with dangerous fumes as in the cyanide bath.

In addition to hardening, the furnace may be used for softening tempered steel, the bath being maintained at a temperature of about 250 degrees Centigrade for this work. The furnace is manufactured by the General Electric Company, of Schenectady, N. Y.

Tapping Machine with One Belt

This machine has been designed by John J Grant, Cleveland, O., to do away with the second or reverse belt for running the tap out. The machine and the single

FIG. 1. TAPPING MACHINE WITH ONE BELT

countershaft are shown in Fig. 1, while the details are made clear by Fig. 2.

The internal gear *A* is mounted inside the large step of the cone and drives the reversing gear *B* in the opposite direction through the intermediate gear *C* which is mounted on *G*. The tap is driven into the work by the forward clutch *E* and after the work is held stationary, the sliding clutch *F* pulls out of contact with *E* and is brought into engagement with *B*, which turns it in the reversed direction and runs the tap out of the work.

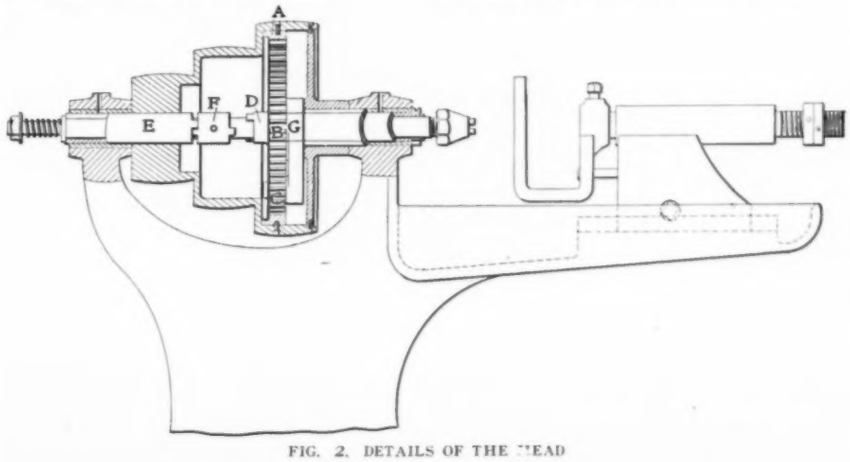


FIG. 2. DETAILS OF THE HEAD

Business Opportunities

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., December 21, for marine boilers, steel, iron, sheet brass, bolts, nuts, washers, pipe fittings, valves, cocks, steam gages, gage glasses, oilers, ball bearings, lathe chuck, reamers, pipe cutters, saw blades, bit braces, etc., as per circular No. 482.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration" or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E.G. Smith Co., Columbia, Pa.

Test indicators. H. A. Lowe, Cleveland, O.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Braze cast iron with Universal Fluxine, $.50 per pound. Universal Fluxine Co., Urbana, Ohio.

Machinery built to order. Up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Send for circulars and price list of radius gages, metal tool box and ratchet tap wrenches. F. G. Marbach, Medina, Ohio.

Machines designed; automatic, special. Practical working drawings; C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric and Machine Co., Paterson, N. J.

Wanted—Articles to manufacture by contract or will buy patent, tools and fixtures outright, by a manufacturer having a large and well equipped plant and capital. Address Box 564, Erie, Penn.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendency wanted by energetic mechanic with knowledge of costing and organization and a producer. Box 704, AM. MACH.

Wanted—Position as superintendent or foreman of marine or general repair shop, or shop manufacturing special machinery; fairly good draftsman; have had 16 years' experience. Apply to "F. B. S.," 169 Crystal Ave., New London, Conn.

ILLINOIS

Designer, technical graduate, 6 years' experience, machine tools, automatic machinery, special tools for light high-grade machinery. Box 692, AMERICAN MACHINIST.

I would like to correspond with any firm needing the services of a young and experienced office manager or factory executive; Chicago or the West preferred. Box 699, AMERICAN MACHINIST.

Wanted—Position as advertising manager; have had years of experience in building catalogs, booklets, folders, etc., also have a practical knowledge of printing values and all details in connection therewith; I hold similar position at the present time, but for good reasons desire a change. Address "A. R. M.," 1457 Wilson Ave., Chicago, Ill.

INDIANA

Wanted—Position as tool room or machine shop foreman; 24 years' experience on tools and special machinery, the past 12 years as foreman; am married, age 38. Box 693, AMERICAN MACHINIST.

Situation wanted by first-class tool dresser and general blacksmith, familiar with all kinds of high-speed steel; can take charge of shop; best references. Address "Tool Dresser," AMERICAN MACHINIST.

General superintendent and works manager will be at liberty Dec. 1. Few years with high-class concerns in Middle West; experienced in foundry, machine, sheet metal, forge and woodworking lines, with uptodate ideas of shop organization and practice on economical production. Address "Superintendent," 1105 No. Alabama Street, Indianapolis, Ind.

MASSACHUSETTS

Foreman or traveling salesman; 20 years' experience. Box 690, AMERICAN MACHINIST.

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 701, AMERICAN MACHINIST.

MICHIGAN

Young man, thorough, practical mechanic, experienced in superintending the manufacture of automobiles and high grade interchangeable machinery; of good executive ability. Also designer of tools and fixtures and expert on 2-cycle engine work. Open for engagement. Address Box 675, AMER. MACH.

NEW JERSEY

Wanted—Position as foreman pattern-maker; have had 19 years' experience on heavy and general pattern work; seven years' as assistant foreman; best of reference. Box 691, AMERICAN MACHINIST.

NEW YORK

Position wanted as operator on Brown & Sharpe, Acme and Cleveland automatic screw machines. Box 697, AMERICAN MACHINIST.

Draftsman, competent mechanical, technical graduate, 28, with five years' experience, wants position. Salary upon merits. "Capable," 22 East 4th St., New York City.

Designer, age 31, graduate 10 years fine apparatus, special, automatic machinery, fixtures, experimental design, checking; very able man; goes anywhere. Box 702, AM. M.

First-class mechanical draftsman and designer, resourceful and practical, wishes situation in New York City; 12 years' experience, automatic machinery. Box 688, AM. M.

Mechanical engineer, wide experience, maintenance, betterments, new construction, machine shops, iron and brass foundries, power plants, furnaces, drop forge; practical mechanic and executive, technical education. Box 685, AMERICAN MACHINIST.

A foreign representative. Engineer, German, 30 years old, residing in Vienna, Austria, desires to act as foreign representative for American tool and machinery manufacturers; thoroughly experienced; highest references. Address "L. S.," 650 Third Avenue, New York.

A man of 22 years' practical shop experience with some of United States largest manufacturers is at liberty to take a position as superintendent or manager; have had exten-

sive experience in gas engine building and have reduced costs from 25 to 100 per cent. Thoroughly understands shop systematizing and the designing of special labor-saving tools. Would take moderate salary and percentage on company's net earnings. Box 698, AM. M.

PENNSYLVANIA

Expert designer on Corliss engines, pumping and blowing engines, power transmission, is open for engagement. Competent to take charge. Box 662, AMERICAN MACHINIST.

Designer, skilled in originating and developing special and automatic machinery and overlooking construction; expert in printing and numbering machinery. Box 695, AMERICAN MACHINIST.

Designer: American, 17 years' experience as machinist, toolmaker and designing general small and medium machinery and tools, and in charge of shop and drafting room departments; small salary until ability is demonstrated; Central or Eastern location preferred. Box 696, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

A prominent Chicago machine tool merchant desires to engage the services of three first class salesmen of established ability who are well and favorably known to the Middle Western trade. Box 631, AMER. MACHINIST.

INDIANA

Wanted—Two inspectors, two grinders, six lathe men, two toolmakers, one foreman, four machinists, all for work on gasolene motors. Good wages. Box 666, AMERICAN MACHINIST.

KANSAS

Wanted—Blacksmith for foreman of college shop. Require an expert smith who has ability and patience to instruct students. Salary to start $900.00 for 11 months. Box 663, AMERICAN MACHINIST.

MARYLAND

Wanted—Mechanical draftsmen, thoroughly experienced in heavy machinery and general arrangements. Address stating experience and salary desired. Ellicott Machine Company, Baltimore, Md.

MICHIGAN

Wanted—Chief inspector and progressive man, machine shop foreman, erecting subforemen and machinists at once. Box 700, AMERICAN MACHINIST.

Wanted—A number of operators on Jones & Lamson, Potter & Johnston and National Acme machines, both day and night work. Must be men of first-class experience. Cadillac Motor Car Company, Detroit, Michigan.

MINNESOTA

Wanted—Foreman for machine shop and assembling room, in an agricultural implement plant, located near Minneapolis; must be a thorough, uptodate mechanic, familiar with agricultural implement work, and competent to handle men. Answer, giving age, wages required and references. Box 694, AM. MACH.

MISSOURI

A large electrical manufacturing company requires a capable, experienced foreman for its indicating instrument department; previous experience indispensable. Apply, giving experience and salary expected. All communications confidential. Box 680, AM. M.

NEW JERSEY

Wanted—Man for hardening and tempering department in a fast growing manufacturing plant; must understand pack hardening, also have some knowledge of the treatment of alloy steels; good position to the right man; state at least three references and wages expected. Box 689, AMER. MACH.

NEW YORK

How would you like to increase your income? If you're a machinist and know other machinists or draftsmen, you can do it easily. We want you to act as our special representative in your shop for the American Machinists' Handbook. This is the best book by all measures that has ever been published by machine makers. When you sell one to a man you're doing him a favor and he'll tell you so after he's had the book awhile. They are outselling all other books. We've a very liberal proposition to offer you and suggest you write us today. Book Dept., Hill Publishing Co., 505 Pearl Street, New York.

OHIO

Draftsman for machine tool work. Wide experience necessary, preferably turret lathes and tools for same. Give detailed particulars regarding experience and state age and education. Address Box 664, AMER. MACH.

PENNSYLVANIA

A man who has had experience in tool making for light stamping and as shop foreman; a good position in an established business for a man of ability and character. No other need apply. Box 703, AMERICAN MACHINIST.

WASHINGTON

Wanted—By prominent engineering house on the North Pacific Coast—a practical mechanical draftsman. One acquainted with power plant design preferred. Splendid opening for one who is in earnest. Address, giving full particulars as to qualifications, salary wanted, etc. Box 647, AMERICAN MACHINIST.

For Sale

For Sale—One second-hand Wheeler planer, 22x5 ft., $125. S. M. Langston, Camden, N. J.

For Sale, absolutely new, a No. 2½ heading machine and a No. 2½ reheading machine, Waterbury-Farrel make, never used. Ohlen Company, Box 740, Columbus, Ohio.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horsepower vertical and 3, 5, 8, 10, 12, 16 and 20 horsepower horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser. Box 366, AMERICAN MACHINIST.

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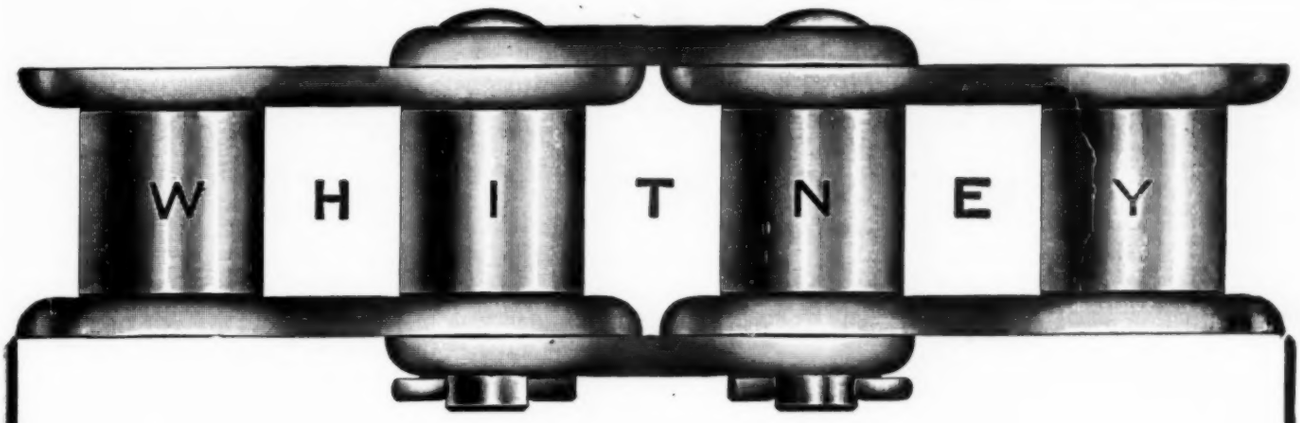

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Investigate the great improvements in "Whitney" Roller Chains for the Season of 1909.

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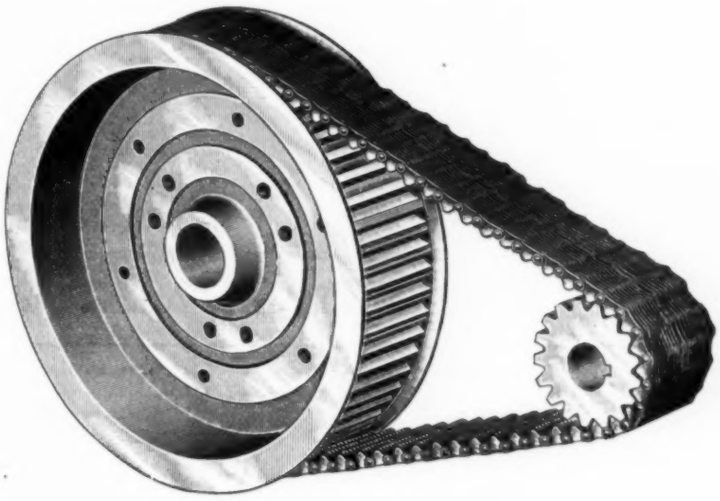
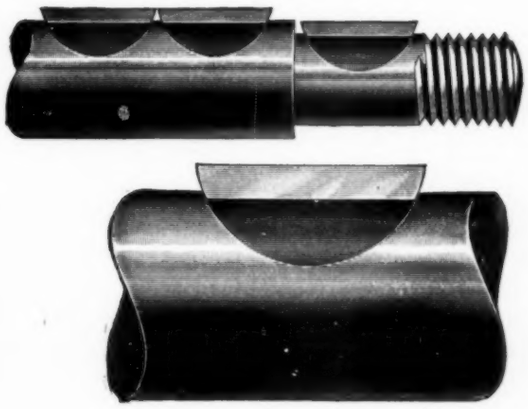
(Schmidt Patent)





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Better results and a great saving in cost.

We carry 95 regular sizes of Keys and Cutters in stock for immediate delivery.

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See Hoists, Hand.

Blocks, Die

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Blowers

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

Keuffel & Esser Co., Hoboken, N. J.

Blue Print Paper

Keuffel & Esser Co., Hoboken, N. J.